

MEMOIRS
OF THE
GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

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UNDER THE DIRECTION OF

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NOTICE.

The present issue of the *Palæontologia Indica*, being a continuation of the descriptions of the fossils from the South Indian cretaceous rocks, contains the first portion of the GASTROPODA, embracing the PULMONATA, and the PROSOBRANCHIA SIPHONOSTOMATA.

This part contains the four fasciculi due for the year 1867-68, now issued in one: the four succeeding fasciculi will complete the GASTROPODA.

T. OLDHAM.

• " CALCUTTA,
March 31st, 1867.

INTRODUCTORY REMARKS.

WHENEVER a large number of different natural objects is to be described, it is always most desirable, that this be done according to some certain systematic arrangement. In palæontology, where the fossil forms are sometimes so very different from the living ones, such an arrangement is almost indispensable, as it is the most essential guide to understanding the relationship between the present and the former organisms. It is well known that, although species, genera, and other higher divisions of the animal kingdom have become extinct during the course of time, they still form a part of one universal system of organic life on our planet. The principal task, therefore, of the palæontologist is clearly to examine these fossil remains with reference to their relations to existing forms, and thus, in co-operation with the zoologist, gradually to furnish the materials for a true natural system in the animal kingdom.

In bringing before our readers the descriptions of the Gastropodous remains of the South-Indian cretaceous rocks, we have tolerably extensive and varied materials to deal with. It may, therefore, not be out of place to offer, first, a few remarks on the classification of the Mollusca in general and subsequently on that, which is to be adopted in our present more special and limited case.

Several conchologists regard the GASTROPODA as the most highly organized of the Mollusca; and taking into consideration that they include forms with usually a well-developed head, organs of generation and of respiration, etc.,* this classification will appear by no means unfounded. The Cephalopodous form is certainly of a type lower in its organization, but it had attained, so to say, the maximum, or at least a much higher grade, of development in a certain direction, or upon a certain plan, in which gradual progression seems to have taken place in the organization of the Mollusca. The functions of several organs in the CEPHALOPODA—those of the central nervous, as well as others of the muscular and the generative systems—in general appear, however, to give to this class a higher place in the general arrangement of the Mollusca than to the GASTROPODA, and on this account it was that the former obtained, especially since the times of Lamarck and Cuvier, the first rank among the Mollusca. A careful comparison of the different systems, which had at various times been proposed, will be found in

* Many of them being air-breathers solely.

the third volume of Bronn's, 'Klassen und Ordnungen des Thier-reiches,' pp. 8 and 9. It will be sufficient here to refer to this valuable publication, and to restrict our own remarks to one or two arrangements proposed subsequently to that publication.

Dr. Mörch in a paper* 'On the systematic value of the organs . . . in the classification of the Mollusca' arrives at the conclusion, that the locomotive, respiratory and other organs, which had been previously—by Lamarck, Cuvier, Blainville,† and others—used as the leading principles in classification, do not really possess the value attributed to them; but that this is to be found in the 'heart' and the 'generative organs.' The author consequently divides the Mollusca (from which, strangely enough, he excludes the BRYOZOA, BRACHIOPODA and others) into two series, MONOTO-CARDIA and DIOTO-CARDIA. Each of these is further separated into two classes, namely, Androgyna and Exophallia on the one, Pseudophallia and Acephala on the other hand. The air breathing Univalves are considered of all the Mollusca the highest, and the monomyarian Bivalves the lowest in organization. As an instance, we may refer to the CEPHALOPODA, which are represented as being a little degree higher in organization than the PELECYPODA, forming with the *DENTALIIDÆ*, the POLYPLACOPHORA, CYCLOBRANCHIATA, part of the SCUTIBRANCHIATA, *Helicina* and others, the class Pseudophallia. In fact such heterogeneous forms are brought together in this newly proposed classification, that no practical success seems likely to follow from its adoption, although several good hints regarding the development of certain forms from others appear to be contained in it.

Very instructive information is embodied in another paper on the classification of Mollusca based on the principle of cephalization by E. S. Morse.‡ The plan, upon which the Mollusca are organized, is stated to consist principally in the form of the fleshy sac containing the viscera and stomach. Mr. A. Hyatt consequently proposes to replace the name 'MOLLUSCA or MOLLUSCOZOA,' by the more appropriate one, SACCATA, equivalent to, and corresponding with, the names VERTEBRATA, ARTICULATA, and others. The morphological researches of Mr. Morse are quite in accordance with the generally accepted classification of the Mollusca, namely, into BRYOZOA (CILIOPODA§), BRACHIOPODA, TUNICATA (TUNICOPODA||),

* Ann. Mag. Nat. Hist., London, 1865, 3rd Ser., Vol. XVI, p. 385.

† Vide Principes de Zoologie, ou class. d. animaux, Paris, 1863 (Posthumous).

‡ Amer. Jour. Sc. and Arts, 1866, 2d. Ser., Vol. XLII, No. 124, p. 19.

§ We propose this name with reference to the cilia, or tentacles, surrounding the aperture.

|| Proposed, with reference to the entire mantle serving, by its muscular action, or through its different appendages, as a locomotive organ.

PELECYPODA, GASTROPODA and CEPHALOPODA, arranged in order from the lowest to the highest type. These six principal divisions or classes of the Mollusca are generally accepted by the majority of conchologists, (with the exception of the CRIOPODA, the Molluscos characters of which are only very slowly acknowledged).

Confining ourselves at present to the GASTROPODA, and in a case like the present, when reporting only upon an imperfect local fauna, it would perhaps be a great advantage, if we strictly followed some system, which had been adopted and exemplified in any of the leading Manuals of the Mollusca. It is not, however, easy to select from among the numerous systems which have been at various times proposed one equally well suited to the zoologist and the palæontologist.

In Woodward's 'Rudimentary treatise of shells,' the general classification of the GASTROPODA is much clearer and more easily understood than in many other Conchological works; and the ways, in which the families are described according to their respective relations, appear to be adequate to the state of our yet very imperfect anatomical knowledge of the animals. This treatise is undoubtedly indispensable for the student of Conchology; still it would at present seem more advisable to carry out in the generic nomenclature a more detailed division, than has been adopted by Woodward. A similar objection,—if it can be called one,—may be raised against the classification in Philippi's 'Handbuch der Conchyliologie,' 1853; and still more decidedly against the older systems of Lamarck and others.

The adoption of smaller and more easily defineable generic groups has, during the last few years, been found not only to have increased very considerably our specific knowledge of the animals, but it has also most remarkably facilitated the study of the Mollusca in general. Many points in morphology and in geographical distribution, which would scarcely have had a chance of being so soon cleared up, so long as the universal generic denominations such as *Cerithium*, *Fusus*, *Tritonium* and others remained in use, became at once far more intelligible in consequence of the new system of sub-division. Perhaps it would be more correct to say, that the more detailed studies of the organization, the habits and the geographical distribution, rendered this closer division more a matter of necessity than of mere convenience, as it appeared to be at first. Swainson, in his able 'Conchology' (1840), was one of the first, who classified in the more recent sense the GASTROPODA into a number of characteristic families and sub-families, and he also nearly doubled the then existing number of genera. The same course was more systematically pursued by Dr. J. E. Gray, especially in his last 'Catalogue of the Mollusca in the British Museum' (1857), and by Henry and Arthur Adams, in their 'Genera

of recent Mollusca' (1853-58). It is greatly to be regretted, that in neither of these two publications have the fossil shells been included, because without these it is impossible to complete a system. This want ought to have been supplied by Chenu's 'Manuel de Conchyliologie,' (Pt. 1, 1859), which is little more than a translation of H. and A. Adams' 'Genera', but with the addition of a large proportion of the fossil forms, so far as these were known to the author. In the numerous and well-executed, though not always very correct, drawings this 'Manuel' has its own strong recommendation. The system of the 'Genera' is, however, strictly adhered to, and the genera of fossil shells are simply inserted in the scheme of the recent ones, although upon a little more consideration the former would have suggested several highly desirable alterations. This reduces the originality and partly the value of the book, specially as it has often been left without many important observations on families and genera, which are given in the English original.

One of the most valuable contributions to the general knowledge of the Mollusca will be found in the third volume of Bronn's 'Klassen und Ordnungen des Thier-reiches' (1858-63), forming a copious compendium of nearly all existing information regarding that division or sub-kingdom of animals. The anatomy of the animals, the formation of the shells, the systematic, geographical, and geological distribution are treated of more extensively, than can be found in any other similar Manual. It is only to be regretted, that it has not been the good fortune of the originator of that grand publication to complete it. The systematic arrangement of the Mollusca is in many respects an original and improved one, while in others it presents an apt and careful selection from what was already known.

Bronn's chief divisions of the MALACAZOA are ACEPHALOMALACIA and CEPHALOMALACIA. The latter contain the CEPHALOPODA, GASTROPODA, and SCAPHOPODA. The first of these, which is considered the highest in organization, has been already treated of in our previous publication of the South-Indian cretaceous fauna.*

The SCAPHOPODA, PROSOPOCEPHALA, or CIRROBRANCHIA, include the single family *DENTALIIDÆ*, while all the rest of the headed Mollusca are treated by Bronn in the class GASTROPODA, which is divided into the following orders: PTEROPODA, Cuvier; OPISTHOBRANCHIA, M. Edwards; HETEROPODA, Lamarck; PROSOBRANCHIA M. Edwards; PULMONATA, Cuvier. The PROSOBRANCHIA, which include the majority of known shells, are further divided into *CHITONIDÆ*, *CYCLOBRANCHIA*,

* *Palæontologia Indica*, Ser. I and III.

ASPIDOBANCHIA, CTENOBANCHIA, and NEUROBANCHIA ('Pulmonifera operculata,' H. and A. Adams). It is not our object here to enter upon any discussion of the value of these various divisions; but looking first at the PROSOPOCEPHALA, or SCAPHOPODA, it is evident from Bronn's treatise (loc. cit. pp. 523-564), that many of the characters of the *DENTALIIDÆ*, as the presence of tentacles (though numerous) on the head, the close connection of the foot with at least a portion of the digestive organs, the unilateral opening of the genital organs, the teeth on the radula and others, are in many respects the same as those in the largest number of other GASTROPODA. It is true that, according to the latest researches of Lacaze-Duthiers and Sars, the *DENTALIIDÆ* appear to be in many respects of a much lower organization than had been previously believed. It is said that they have no heart, nor any special respiratory organ, and that the entire surface of the body, not attached to the shell, acts as the latter, although this last statement does not appear to be satisfactorily proved as yet. We have among other GASTROPODA also many instances of a very low organization, for we meet with species, which have no heart, and consequently no regular circulation (in *Rhodope* of the OPISTHOBRANCHIA); others which have no mouth or special organs of respiration (many GYMNASOMATA of the HETEROPODA), and still, looking to the totality of the organization, we cannot but retain these and other forms in the respective orders, or families, to the species of which they are in other respects closely related.

Comparing, on the other hand, the five sub-orders of the PROSOBRANCHIA, the assemblage appears to us rather heterogeneous; and we would suggest to exclude from them the first and the last, namely, the POLYPLACOPHORA, (*CHITONIDÆ*), and the NEUROBANCHIA, classing these as separate orders, equivalent to the PROSOBRANCHIA. Both are entitled to this rank; the former by the want of tentacles and the articulated shell, and the latter by the respiratory organ, and consequently different mode of life. We would then have, as formerly acknowledged, only two divisions in the CEPHALOMALACIA, namely, CEPHALOPODA and GASTROPODA. The latter could then be further divided into eight orders: 1, PULMONATA; 2, NEUROBANCHIA; 3, PROSOBRANCHIA; 4, HETEROPODA; 5, POLYPLACOPHORA; 6, OPISTHOBRANCHIA; 7, PTEROPODA; 8, PROSOPOCEPHALA.

In the course of our descriptions, we shall retain this classification, although only four of the orders, the PULMONATA, PROSOBRANCHIA, OPISTHOBRANCHIA and PROSOPOCEPHALA, (or SCAPHOPODA), will occupy our special attention, because of the other orders no representatives have as yet been discovered in the South-Indian cretaceous rocks.

As to sub-orders, families and genera we shall to a great extent follow Gray's 'Catalogue,' or H. and A. Adams' exposition, in their 'Genera,' although we shall not refrain from making such alterations as appear called for by the examination of the fossil shells.*

Until within the last few years, it has been the usual custom in fossil Conchology to follow a few standard works, which had been carefully executed in accordance with the systems of Lamarck and Cuvier. There can be no question that this course very greatly facilitated the understanding of the general character of the shell, especially where the palæontologist had to deal with only a small number of species. Still a great drawback in fossil Conchology has been produced, in that the comparison of the extinct forms with living ones has been so much neglected, or at least retarded. A large number of generic names has thus been introduced into the literature of Conchology, very often for no other reason than that all the species belonging to them were extinct, or at least were believed to be so. Fossil shells also were occasionally treated solely with reference to their identity, similarity, or difference as compared with those already described from the same or similar deposits, and as being characteristic for a certain geological formation. It is only natural that the importance of the last point should not be overlooked by the palæontologist; but it was not until Ed. Forbes, Darwin, Dana, Lyell, and others showed the vast importance of applying results, derived from the study of physical conditions in connection with the recent fauna, to the examination of the fossil faunæ, that the great physico-geological results, which we now see rapidly progressing, received that attention which was due to them. It was proved that species of a certain form and organization only live or prosper under certain favorable circumstances, at a certain depth, temperature, and other conditions of the water, or climate, on certain ground, &c., and that from an examination and correct recognition of the characters of the fossil shells, it is possible to form correct conclusions as to the past physical conditions, under which the respective strata have been deposited. An enormous field of new and most interesting inquiry into the former conditions of life on our globe was thus opened for the geologist and palæontologist. The 'formations' of the geologist ceased to be looked upon merely as a series of beds with some characteristic fossils, but appeared in the light of a series of beds deposited under various physical conditions and in a great ocean swarming with organic beings, which were adapted to those various conditions.

* The want of references vastly increases the difficulty in the critical use of the book, and is, as well as the very strange and unusual names occasionally adopted, justly complained of by many conchologists.

Changes made on one side proved the necessity for others, and it was seen that by no better and more accurate means could the correct comparison of the former with the present physical conditions be tested than by the study of the organic life, and specially of that of the Mollusca. It was then necessary to go into a closer comparison of the fossil* forms with the living ones, and to make use of the considerable systematic progress which had been attained in recent Conchology principally through anatomical researches.

The great disadvantage in studying fossil forms is, that direct observation as to the connections existing between the animal and its shell are to a great extent still in their infancy. It is most important to know which particular secretion on the aperture corresponds to a certain organ, and in what connection this latter stands to the total organism; whether its changes are essential and necessarily dependent upon others in the organisation of the animal, or whether they may be produced by, and can therefore be attributed to, local and accidental causes only. We can hardly expect, that our fossil genera will have an unquestionably firm basis, until these morphological and anatomical studies have been very considerably advanced. It is, however, by no means intended to say that our present knowledge of the anatomy of the animals is so totally deficient, that we cannot form any certain conclusions from the structure of the shell to that of the animal. We do not need to enumerate the many most valuable results, which have been already obtained from those studies in fossil Conchology.

But the more we enter into a detailed examination of local faunæ, the more urgent appears the necessity for reducing to some extent the old established 'grand' generic groups, and for adopting instead the smaller and more easily definable genera, which have been established by the more rapid progress of recent Conchology. I hardly need to repeat, that our studies, both systematical, as well as physical and geographical, are most remarkably simplified by the adoption of this course. That we shall have to struggle, for some time to come, with the number, limit and definition of those genera is an undoubted fact, but this does not in the least invalidate the principle, which ought to be adopted. It is most probable, for instance, that a large proportion of the genera and sub-genera, introduced by H. and A. Adams in their 'Genera' will prove to be quite unnecessary, others will be differently determined, and many more are constantly proposed. But when all the recent shells have been thus carefully examined, several of our, as at present believed, fossil genera will be shown to have still living representatives, and others, which have really disappeared altogether, will be entered into the system according to

* I mean to refer here principally to the meso- and palæo-zoic fossils.

their respective relations. The recent fauna is only a remnant of that which existed during the previous periods of life on our globe, and its uniform plan of organization is sufficient proof that, strictly speaking, the present fauna marks only a certain stage in the entire progressive development of organic life.* Unless, however, I am very much mistaken in the meaning of the term of a *natural system*, (which I believe ought to be *the exposition of this gradual development of organic life*), I am entirely at a loss to perceive, how conchologists can expect to arrive at a natural system from and through the examination of the recent species alone!

Were it certain that there are in reality no extinct, new, or differently typical, forms of Mollusca known, no such objection could be very reasonably raised; but as the reverse is to the extent of our present knowledge an undoubted fact, the conchologist must look upon a purely zoological system only as a partial systematical arrangement, or an incomplete attempt at a natural system.

Perhaps the system now adopted, which has become so highly favoured among a number of conchologists, might well be called hyper-anatomical. It sounds almost like a dream to hear of the grand results, which are expected to be derived from the examination of the dentition of a few species, when Mr. Mörch says, that "a monographic research, chiefly based on the teeth of the genera *Nassa*, *Fusus* and *Buccinum*, found on the coast lines from the arctic regions to the equator, would probably be sufficient to prove, whether species in *each fauna* are created originally, or are only varieties dependent on different climates, and would at the same time prove the relations between the species of succeeding geological periods." Where, whether, and how all these inquiries of the past and the present are inscribed on the teeth of the Mollusca will probably not be easy to find out. This seems to me a similarly exaggerated idea, as if some palæontologist would attempt to obliterate a carefully obtained zoological result through the examination of a few imperfect shells, for such they are in the largest number of cases in our fossil Conchology. It is only by the co-operation of both the zoologist and palæontologist (although the latter will always gladly give the lion's share to the former), that a true natural system of Conchology can be obtained.

For some time I entertained the project of collecting all the different types of Mollusca, and specially of the GASTROPODA, from the oldest to the more recent formations, and thus being in possession of a series of types for comparison with the living shells. A task like this is, however, not easily executed, for the

* When certain highly organized forms are placed under the influence of conditions of life so different, that their organs lose something of their inherited development, instead of becoming more highly specialized, this case of so-called retrograde metamorphosis can scarcely be looked upon as anything more, than an exceptional case, inasmuch as it does not interrupt the general tendency to progression.

geological position and the probable conditions, under which the respective fossils lived and were buried, ought to be always correctly ascertained. As soon as our palæontological materials are more complete, such a series of shells will prove highly instructive. We have to compare then the series of each successive formation with the preceding, note the changes of form with reference to that of organisation, inquire into the causes which may have produced these, and deduce from this the direction, plan and degree of progressive development. Such a thorough examination of the entire fossil and living order of the Mollusca in one locality, or rather so to say in one basin, or geographical area, would give us a better and firmer basis for a natural system than anything else, and when such inquiries have been in reality, so far as possible, extended over the entire globe, we shall have then in hand at least a portion of the materials, which we require for that system. We must, of course, necessarily be contented with a certain number of typical forms, for to obtain all the fossil species which have existed is almost beyond our expectation.

This is the principal reason why, in describing a large local fauna, we thought it right to take advantage of the opportunity for the proposition of a few systematical changes.

In conclusion I ought probably to say a few words in justification of the great length to which my memoir on the GASTROPODA has been extended. It was indeed only after mature and repeated considerations, that I entered upon the difficult and laborious task of making references to the recent fauna at all. When, however, I found the necessity for adopting a large number of generic names instead of one, as used by several other palæontologists, the further necessity arose of grouping these into families and so on. In giving occasionally a review of the cretaceous genera and species of a family already known, it was almost impossible not to mention at the same time other recent genera of the same family. In this way the bulk of the information increased, and I afterwards thought it useful to give, besides, a brief review of the zoological character of each family or sub-family if necessary, so as to aid, even slightly, the student of Conchology in India, where the desirable means of reference are not so easily procurable, as they are in almost every large town in Europe.

Several other additions and explanations of little known genera of shells will perhaps be welcome even to some of my colleagues in the study of Conchology.

F. STOLICZKA.

CALCUTTA,
MARCH 1867.

GASTROPODA

OF THE

CRETACEOUS ROCKS OF SOUTHERN INDIA.

Sub-kingdom, **MOLLUSCA.**
 Class, **GASTROPODA, Cuvier.**

CHARACTERS.—*Mollusca*, with a more or less distinct head, being generally provided with tentacles,* a muscular foot developed for digging, swimming, fastening on submarine objects, creeping, or rudimentary,† with or without other locomotive appendages of different shape; mantle open usually in front and below, more rarely on both ends,‡ or even wanting; shell, if present, either univalve or multivalve,§ with or without an operculum, which is not exactly equivalent to the second valve of the *Pelecypoda* or *Elatobranchia*; genital organs placed usually unsymmetrically, seldom symmetrically,|| or in pairs,¶ but always opening on one side only.

We have previously noticed, that it appears convenient to divide the entire class of *Gastropoda* into eight orders; namely, *Scaphopoda*, *Pteropoda*, *Opisthobranchia*, *Chitonidæ* (*Polyplacophora*, Blv.), *Heteropoda*, *Prosobranchia*, *Neurobranchia* and *Pulmonata*. The cretaceous rocks of Southern India have not as yet yielded remains of all these orders, and there is, therefore, no inducement for us to notice those, which are absent, any farther in detail. For sufficient information as to all the orders and other sub-divisions, we would specially refer the reader to the description in Bronn's "*Klassen und Ordnungen des Thierreiches*," Vol. III (continued by Dr. Keferstein).

The remains of *Gastropoda*, which we are about to describe more fully here, belong to the four divisions, the *Scaphopoda*, *Opisthobranchia*, *Prosobranchia* and *Pulmonata*, and we shall confine our remarks to what may be necessary to the understanding of these four divisions, so far as regards the special purposes of our present description and the geological importance of the groups.

* To these Bronn's name *Pselaphocephala* refers, but as they are wanting in almost a greater number of species, than is the foot, the name is not more characteristic. The tentacles are wanting in a few genera of the *Heteropoda*, *Opisthobranchia*, *Pteropoda*, and in all *Chitonidæ*.

† The foot is wanting in one or two *Pteropoda* and three or four other genera of the *Gastropoda* even as a rudiment. ‡ In the *Dentalidæ*. § *Chitonidæ*. || *Dentalidæ*. ¶ *Chitonidæ*.

As is generally the case, the Prosobranchia are, in the rocks referred to, by much the most numerous. It would be, no doubt, a more natural course to open our descriptions with the lowest group—*Scaphopoda*—but following the arrangement already adopted in the previous descriptions of a portion of the Mollusca from the same rocks (see *Palæontologia Indica*, Cretaceous Cephalopoda of Southern India) we shall begin with the highest order, the *Pulmonata*. Generic characteristics will be given in greater detail where necessary, and especially, when a genus is introduced for the first time into the literature of cretaceous *Mollusca*. Cases will sometimes occur, when a more general,—usually an older denomination of a *genus*,—is retained as the principal name, while a second is given in a parenthesis. The latter usually refers to a name used for the genus in a more restricted, and generally a newer or more recent, sense. We would simply repeat here, that we prefer leaving room for further correction by exposing the insufficiency of the materials at our command, rather than by using terms of fixed meaning to attempt to give an apparent, but possibly fallacious, completeness to the descriptions. Even in some well preserved fossil shells, there still remains for the most part so much that is doubtful, and so much that must be mere supposition, that we must be careful to avoid any hasty descriptions of imperfect specimens, which would frequently admit of more explanations than one.

The geological terms to be used in reference to the cretaceous rocks of Southern India, will be the same* as those already used in the descriptions of the Cephalopoda. Four groups of beds are distinguished; the *Arrialoore*, *Trichinopoly* and *Ootatoore* groups in the Trichinopoly district, and the *Valudayur* group from the neighbourhood of Pondicherry. The last (the Valudayur) may be taken as nearly equivalent to the lowest division (the Ootatoore) of the Trichinopoly series, although the equivalence seems to be only partial. Many of the fossils, which were examined from these beds, appear to indicate, that some Arrialoore beds had been classed with them, and it may even be possible that these younger beds constitute the greater portion of this group. Very strict boundaries between each of the groups were not defined by means of the geological or stratigraphical examination of the rocks. We must hope that the palæontological enquiry, when extended over the entire fauna, may throw some light upon the value of these divisions, and that the distribution of the various groups of fossils will help to explain much as regards the co-existence, or succession in time, of the various deposits.

We may here anticipate the remark, that while the Ootatoore group has yielded the largest number and greatest variety of Cephalopoda, the Arrialoore and Trichinopoly groups contain to the same degree a much richer fauna of Gastropoda. At the close of the detailed descriptions, the results, as regards this class, will be given in the same way, as already attempted with the Cephalopoda. If not specially mentioned it will be understood, that the specimens described or figured are deposited in the collections of the Geological Survey of India. With regard to nomenclature

* These will be found more fully treated of in Mr. H. F. Blanford's report in the 4th Volume of the Memoirs of the Geological Survey of India.

we shall use, in the course of our descriptions, the generally accepted expressions ; to avoid, however, any misapprehension a few remarks will probably not be out of place.

In all our figures, we have adopted the position with the apex of the shell *above* and the aperture *below and in front of* the observer. Strictly speaking the choice of this or of the reversed position, as used chiefly by French Conchologists, depends merely on the habit to which a naturalist has been accustomed. Neither of these positions, as is well known, is throughout strictly natural or corresponding with that of the living shell, and as regards illustration, the one has no peculiar advantage over the other. In a few swimming species, the reversed position may be thought more natural, while the regular position, with the apex above, is in the greater number of conical shells not only natural, but as regards certain fixed terms in common use is decidedly preferable.

As to the different forms of the shells, the expressions used need no farther explanation ; they are all very familiar and easily understood. The name of 'body whorl' applying to the 'last whorl' (*anfractus ultimus*) will be omitted, as it has no real significance in the Gastropoda.

Speaking of the aperture, the expressions 'below' and 'above' will also be omitted, because they are liable to cause misunderstanding in the reversed position of the shell, and the respective expressions 'anterior' and 'posterior' will invariably be used. The same remark applies to the names of 'right' and 'left' lip or peristome, in place of which the corresponding terms of 'outer' and 'inner' or 'columellar' lip are less liable to cause confusion in cases, when any one desires to refer to a figure, for which elsewhere a reversed position has been chosen. If not particularly noticed, we shall understand by 'inner' lip, that portion of the peristome, which adheres immediately to, or covers partially, the preceding whorl, and which is also often called the columellar lip. The posterior angle of the aperture marks, generally speaking, the posterior junction of the outer and inner lip, which are here either *united* or *separated*. The anterior junction of these two requires, however, often a special explanation in the different groups, if it is not clearly marked by the anterior canal, or at least a slight notch of the aperture, as in the greater number of the Prosobranchia.

Considerable difference exists as regards the terms, which are used for the designation of the so-called 'umbilicus.' We shall, in all cases, cease to use the word 'perforated,' because there is in reality scarcely a single Gastropod shell, which can be truly called perforated, and because the original meaning of the term, as first introduced, has in the course of further enquiry been so variously applied, that the simple use of the word now leaves an observer in doubt, or, when no special explanation of the expression is given, rather leads to misapprehension. In our description, we shall use only two principal terms, which we regard as correlated to each other, namely, *umbilicus* and *columella*. The first is either *open*, or *covered* with a callosity, the latter *hollow* or *solid* ; both in different degrees and varying in form requiring always special notice, not only in different species, but often even in certain specimens of the same species.

A shell, which is coiled in a regular plane, is umbilicated on one or, generally, on both sides; but in most cases, the basal (or lower) is deeper than the apical (or upper) excavation. When the volutions are coiled in such a manner, as to rest on the upper part of the succeeding whorl with their whole basis, or only with a portion of it, while the apex of the shell is raised conically, a similar conical excavation is thus formed on the side opposite to the apex, or internally of the shell. In this case we call the excavation an 'umbilicus,' the form and size of which depends upon those of the shell. The central perpendicular axis of umbilicated shells, which expresses their height, is, therefore, only imaginary. Further it depends on the angular or rounded forms of the whorls, and on the kind of involution or coiling, whether the inner volutions are partially visible within the umbilicus, or whether this latter forms a regular hollow cone, as in many *Helicidae*, on the one hand, and in many *Trochidae* on the other. The umbilicus may often be covered with a callose mass, which on the further growth of the shell may be absorbed, or may remain and fill up the excavation. Instances of this kind occur in the *Naticidae*, *Neritopsidae* and others.

When, on the contrary, the basal portion of each whorl is partially covered or embraced by the succeeding whorl in order to form a certain axis, round which the volutions are coiled up, we call this axis a *columella*. The formation of this columella depends on whether the inner lip covers the preceding whorls in its entire extent, or only partially, and whether it is very thin or thickened; according to this the columella is either solid or hollow, and in itself either very thin and loose, or strongly and consistently built by the callose mass of the inner portion of the peristome. Solid columellæ are found in *Fusus*, *Buccinum*, etc., hollow in *Cancellaria*, *Nerinea*; very thin and slight in *Turritella*, strong in *Rostellaria* and *Cerithium*, etc.

The inner lip sometimes remains partially free at the base, so as to form a hollow in the columella. In growing larger, however, the free or raised portion of the inner lip is absorbed and, while forming a solid columella, the same hollow is again restored at the new peristome of the aperture, as is, for instance, observed in some species of *Chemnitzia* and others. In this case, the expression *fissure* may probably be well appropriated. Depending on the peculiar character of the spiral coiling of a shell, it will be seen, that while in some cases there appears to exist a very sharp distinction between umbilicus and columella, in others they approach, or even amalgamate with each other. Taking it very strictly we may say, that a columella is always present, when the singular whorls are contiguous and coiled cone-like. In shells, the whorls of which are not contiguous, as is sometimes the case in *Scalaria*, *Vermetus* and others, we can speak neither of a columella, nor of an umbilicus.

Proceeding with the descriptions of the species, we shall often note a few measurements, as—

- 1.—The spiral angle, according to D'Orbigny's Helicometer;
- 2.—The sutural angle, by which we understand the angle formed by the ascending suture and a horizontal plane at right angles to the axis of the shell.

3.—The proportion of the height of the last, and, occasionally even of the penultimate whorl, to the height of the axis.

It must be understood, that these and any other measurements regarding the actual size of shells will be only noticed, when they can be of use in the reconstruction of the shell, or when they are in other respects characteristic. The scale used will be, as before with the Cephalopoda, the millimetre. There is little use in quoting measurements of already figured specimens, or even actual measurements in general, excepting as regards the usual size of a species, or its greatest variation.

In the descriptions of species we shall, as usual, give first a diagnosis in Latin, while the rest of the description will generally be more explanatory, than a mere translation of the diagnosis. Observations on similar species already known, and comparisons with these will be carefully noted, because these are in many cases of far greater importance, than any imperative characteristic of a new species. Regarding known species, we shall continue to notice largely all facts of identity and affinity, and to illustrate them amply with the specimens at our disposal. Special geological interest always attaches to the occurrence of these known species. The same system will be retained in referring to the different genera and families, and to their geological distribution in time and space, as well as to their conchological relations.

It is not necessary at present to make it an object to enumerate all known Cretaceous fossil species of the genera described, as this work has only just been completed by Prof. Pictet (Mat. p. l. Pal. Suisse, 3rd Ser. 1864.). If, however, any particular additions or considerable alterations have been made since the date of Pictet's publications, we shall not omit to attend to this subject. In 1861 (Proc. Am. Phil. Soc. Vol. VIII.) W. Gabb published a catalogue of what he then supposed to be all known Cretaceous Mollusca. The number of fossils, however, omitted from this catalogue is very considerable, and a little want of care in the critical examination greatly reduces the value, which such a publication, if properly executed, would so highly deserve.

CRETACEOUS GASTROPODA

Order. PULMONATA, Cuvier.

CHAR.—*Air-breathing Gastropoda with or without a shell; lungs situated in front of the heart or behind it, and the respiratory cavity opening with a roundish hole only; hermaphrodite, with reciprocal impregnation; without a metamorphosis, the young animal resembling the parent in shape and not provided with deciduous, cephalic fins.*

In conformity with the somewhat limited extent of dry land during the earlier formations, air-breathing animals seem not to have been very numerous, although they were not wanting even in some of the oldest periods. The first somewhat doubtful remains of air-breathing Gastropoda are found in the coal-measures and not very certain traces were noticed in fresh-water deposits of the Lias and Jura. True Pulmonata were described first from the Wealden, but the remains even here, and in the cretaceous deposits, are very scarce. By far the greatest number, which is calculated to amount to about 600 species, have been derived from the Cainozoic deposits, the Eocene, as well as the Neogene. From our cretaceous rocks, only a few species have been procured, and these all belong to the

Sub-order. Stylomatophora.

the members of which are all terrestrial animals characterized by having their eyes on the ends of retractile peduncles, the tentacles being separate and placed below the peduncles; no operculum.

Family.* HELICIDÆ.

Sub-family. HELICINÆ.

Except the *Boysia Reussii*, which was in 1859 described by myself from a cretaceous fresh-water deposit in the North-eastern Alps,† I am not aware that any species of true Helicinæ‡ have been noticed from deposits lower than the Eocene strata, although I may be unacquainted with some publications at present bearing on this point. The four species, here described under two genera, are, therefore, of very great interest, both in the study of the *Pulmonata* in general and in that of the fauna of the South-Indian cretaceous deposits especially. The greater number of our specimens were found in the loose conglomeratic or gritty sandstones of the Arriallor group, or the highest division of the series of deposits, together with marine shells. This mode of occurrence increases the interest of these few Helicidæ very much, and supports Mr. H. Blanford's statement, that the Arriallor deposits have been formed, partially at least, in very shallow waters.§ Land was evidently not very far off, and it cannot surprise us, therefore, when we see land shells occurring associated with a rich fauna of truly marine species. Helicidæ inhabited the shores and islands of the cretaceous sea, and consequently their shells

* We accept the terminations of—*idæ* and—*inæ* for the denominations of families and sub-families respectively.

† Sitzungsab. Akad. Wien. Bd. XXXVIII. p. 493, pl. 1, fig. 17.

‡ *Helix Gentii*, and other species noted by Sowerby are now universally acknowledged as *Natica*, *Trochus*, etc.

§ Mem. Geol. Surv. India, Vol. IV, pt. 1, p. 163.

could, by occasional higher tides or higher reach of the waves, have been without any difficulty carried away to greater or lesser distances from the shores, and there buried with the marine inhabitants of the place. Similar cases occur in the tertiary deposits also, as has been noticed by Deshayes in the Paris basin, and by Dr. M. Hörnes in the Vienna basin. With regard, indeed, to the *Helix Turonensis*, Desh. of the latter basin, it has been proved that the species survived the marine fauna with which it occurred. The species continued to exist on unaltered, although the sea had disappeared from the shores which it inhabited, since it has been found fossil in the marine, brackish and the fresh-water deposits of one and the same place, where these deposits can be very clearly seen to have succeeded each other.

This is a point of very high interest and of great importance in attempting to trace out the changes of climate, and other correlated phenomena, towards the close of one and the commencement of another formation. When we can establish, that the terrestrial fauna did not change during two successive periods, in which considerable changes and distribution of sea level took place, we can conclude with tolerable certainty, that the climate of the place was, during both these periods, pretty nearly the same, and also, that if any changes have taken place, they must have occurred by so slow a process, that the animals could easily acclimatise themselves. Sudden changes in the terrestrial faunæ would lead us to suspect some rapid alterations in the climatal conditions and configuration of the land, and probably an equally sudden change in the neighbouring waters. But our physico-geological investigations are still too deficient to enable us to define the limits, within which terrestrial changes have affected the organic life of the adjoining seas and *vice versâ*. It is, however, certain that much knowledge may be anticipated from careful local enquiries and thorough examination of special basins. Instances of an admixture of land with marine shells occur still on the shores of almost every sea, more especially where banks with shallow water exist.

Of the four species to be here described, *Anchistoma cretaceum* was more common: the other species were very rare, but although only known from single specimens, these are mostly sufficient to enable us to characterize the species, and, therefore, are well worthy of notice. This will also, I hope, induce subsequent observers to devote greater attention to these very interesting shells. It can scarcely be doubted, that a careful search in these deposits would largely reward the observer, by adding to the number of cretaceous land,—and probably fresh-water,—shells also.

H. and A. Adams unite, under the sub-family of *Helicinae*, a number of genera into which Lamarck's genus *Helix* had been divided. It is well known, that Linnæus included, under *Helix*, besides the common land-snails, many fresh-water and even marine shells. Subsequent naturalists, and especially Lamarck, defined and restricted the genus more carefully, and among others Pfeiffer made it an object of his special study, the results of which are well known through his able monograph of the *Helicidæ*. In his earlier publications, Pfeiffer strictly defended the unity of Lamarck's genus *Helix*, in his later researches he does not

appear indisposed to adopt a division of the old genus, *Helix*, into smaller groups under different names. And there can be no question that such sub-division is rendered quite necessary even in the present imperfect state of our knowledge of all the respective animals.

With all the apparent similarity, the variation in the form of the shell and coincidentally, to some extent, in that of the animal itself, is still so manifold, that it is not easy to characterize even the sub-family *Helicinae*, in its restricted sense, as given in the more recent Conchological treatises. But what the characteristics of the genus *Helix* in Lamarek's sense might be, is readily seen when we read in Woodward's Manual, or Bronn's 'Klassen und Ordnungen' a. o., that it comprises shells of discoid, globular and conical form, umbilicated, perforated or imperforated; with a transverse, oblique, lunar or round aperture; with its margins distinct, remote or united by callus!! etc. No one can fairly or seriously object, if Conchologists attempt to classify these and other so widely different characters under different names.

Of this sub-family, *Helicinae*, we notice two genera *Anchistoma* and *Macrocyclus*.

I.—ANCHISTOMA, *Klein*. 1753.

Anch. testa orbiculari, spira plana seu subconvexa; anfractibus numerosis, subtilis omnibus vel duobus ultimis conspicuis, seu umbilico clauso; ultimo anfractu prope aperturam contracto, deflexo atque nonnunquam gibboso; apertura subrotundata, expansa, intus sapissime callosa, ad margines dentibus seu plicis munita.

The genus *ANCHISTOMA* comprises a number of chiefly small species of *Helicinae*, which are distinguished by a large number of narrow whorls, the last of which is deflexed and usually provided inside with some kind of teeth or plaits. The inner lip is mostly callose, tooth-like and projecting into the space of the aperture, while the outer lip is expanded and reflected. There can be no doubt, that the species attributed to this genus, as they can be seen amply illustrated on plates 64—66 in Pfeiffer's "Schnirkel-schnecken" 1846, form a sufficiently natural group to be distinguished by a separate name. Among themselves they present, however, several characters which seem to make a still farther sub-division into small groups very desirable. We notice in general the helicoid and non-umbilicated forms with somewhat elevated spire, and the more planorboid and umbilicated forms. Among these again those which have all their previous volutions visible in the space of the umbilicus, and others in which the last or the two last whorls are so much enlarged below, as to cover this space nearly totally. Similarly to this the dentition of the aperture varies. The peristome is only somewhat thickened and expanded; or there are a number of plaits or folds present in the inside of the whorls, disappearing near the mouth partially or totally; or there are differently shaped teeth at the peristome only and not extending into the inner spaces of the whorls.

Considering these and other points of distinction H. and A. Adams quote five subgenera, which, however, do not seem to be as well defined as appears necessary. To make these separations of real classificatory value, it is absolutely necessary, that they be based upon the examination of the animals as well as the shells, so as to be certain whether the respective organs can in any way be depended upon as to their constancy. Meanwhile we prefer to describe the cretaceous species under the more extensive heading of *Anchistoma*.

The greater number of living species of *Anchistoma* is known from America and Europe. From India there are only a few species described for some of which Adams proposed the name *Corilla* (in place of *Atopa*, Albers). Mr. Benson includes under this name mostly South Indian and Ceylon species only, while for some others, chiefly from Burmah and North India, he proposes a second name, *Plectopylis*, based upon a difference in the pyloric plication. (*Vide* Ann. Mag. Nat. Hist. 1860, III, Ser. Vol. V, p. 243.) It appears that the species were in former periods nearly as numerous as they are at present in India. We describe three, namely, *A. cretaceum*, *Arrialoorensis* and *Arcotense*, all of which are new, and the first, apparently rather a common shell resembling in form European species, while the two others have up to the present been found only in single specimens also partly resembling species from Europe, but in general form next to the Indian *Plectopylis*. Several *Anchistoma* are known from the tertiary deposits of Europe.

1. ANCHISTOMA CRETACEUM, Stoliczka. Pl. I., Figs. 1—5.

A. testa conico-depressa, spira parum elevata, apice obtusa, mamillata, late profundeque umbilicata; anfractibus senis, angustis, lente accrescentibus, convexis, sutura impressa junctis, supra transversaliter oblique striatis; ultimo prope aperturam lateraliter constricto atque rursus expanso, vix deflexo, striis subtus evanescentibus, in ætate adulta ad umbilici marginem rotundato, juniore carinato; apertura obliqua, rotundate semilunari, intus dentata atque obsolete plicata; labro atque labio prope aperturam bidentato, dentibus superioribus crassioribus et bifidis, inferioribus elongatis pliciformibus utrinque ad angulum posteriorem peristomatis nonnullis plicis tenuibus munitis, peristomate exteriori vix reflexo.

Largest specimen in our collection from Comarapolliam measures 8·5 mm. in height and 20 mm. in width.

	a.	b.	c.
Height of the shells : transversal diameters (taken as 1·00),	0·43	0·51	0·54
Width of outer whorl above : transversal diameter ...	0·18	0·17	0·18

a, b, c, being specimens figured in Figs. 4, 5, 3, respectively.

As to form, this fine species resembles the American *Anchistoma auriculatum*, Say, which has very nearly the same number of equally narrow whorls. The spire is in our species more or less elevated, but not exceeding an angle of 130 degrees. The increase of the whorls is very gradual; the first or embryonal one or

two whorls being smooth, and proportionally larger or wider than the following. These are distinctly convex, separated by an impressed suture and obliquely and transversely striated, the striæ disappearing on the sides and on the base of the last whorl. The latter has its greatest width above the centre, becoming gradually narrower towards the umbilicus, the margin of which is in the adult and perfect shell evenly rounded, while in the young shell it is angular or even carinated, as shown in figure 2, Pl. I. The width of the umbilicus at the base amounts to about one-third of the whole basal diameter; but as not more than a portion of the preceding whorl could be exposed from the adherent rock, it is uncertain whether more volutions are visible in its space or not. In any case it is certainly very narrow lower inside. Further, the last whorl is near the mouth, laterally and somewhat below the middle, strongly contracted or compressed. (Fig. 3.b.) To this contraction correspond two strong teeth inside, which have two equally formed teeth corresponding on the opposite inner lip. The upper of these teeth is much stronger, short and bipartite, the lower is fold-like, thinner and longer. Besides these, there are on the upper portion of the inner lip two other thin fold-like plaits, and one near the suture on the outer peristome. These three folds are seen in several of our specimens, but in none extending far inside of the whorl. Close to the aperture, which is of semilunar shape, the last whorl is again, as before, regularly expanded or a little inflated and somewhat deflexed. The outer peristome itself is scarcely enlarged and reflexed, its plane having a position very oblique to the axis of the shell.

Localities. Neighbourhood of Comarapolliam, at Ninnyoor and Veraghoor; at the first locality rather common in soft light coloured sandstone.

Formation. Arrialoor group.

2. ANCHISTOMA ARRIALOORENSE, *Stoliczka*. Pl. I, Fig. 6.

A. testa discoidea, late umbilicata, spira vix elevata; anfractibus quinis, teretibus, supra convexis, sutura impressa junctis, obsolete transversim striatis, lente crescentibus; ultimo antice deflexo, basi rotundato, prope aperturam parum constricto; apertura perobliqua, ovate rotundata: peristomate exteriori expanso, angulatim reflexo; interiore anfractu penultimo adherente, moderate calloso.

Height of the shell : transversal diameter (taken as 1·00)	...	...	...	0·39
Width of one whorl above : transversal diameter	...	...	...	0·23

The shell of this species is nearly discoid, the spire being hardly elevated, but the umbilicus is, so far as it could be traced, very large, occupying nearly half of the total width of the basis. The surface of the shell, which appears to have been very thin and pellucid, is only very finely striated transversely. The whorls are five in number, convex above, separated by a deep suture and very gradually increasing in breadth. The last whorl is widest somewhat above the centre and then evenly rounded into the space of the umbilicus; near the mouth it is strongly deflected being at the angle of deflection somewhat constricted. The aperture is conse-

quently nearly parallel to the horizontal plan of the basis, facing the same; the outer peristome is largely expanded and reflexed, its margins being connected by the inner lip of about the same thickness. No dentition is perceptible in the interior of the aperture, although it may exist farther inside, whence the rock could not be taken out. The specimen, being unique and so far complete as to be easily recognised and characterized in its principal features, is too valuable, to sacrifice it to the examination of the inner space of the aperture. The lateral portion of the outer peristome is in the specimen a little corroded.

As regards general form and number of volutions, our specimen recalls much the European *Anch. holoserica* Studer.

Locality. Near Ninnyoor: the single specimen occurs in pinkish limestone.

Formation. Arrialoor group.

3. ANCHISTOMA ARCOTENSE, *Stoliczka*. Pl. I, Fig. 7.

A. testa discoidea, planorbulari, supra planâ, subtus late umbilicata; anfractibus quinis, angustissimis, lente crescentibus, supra convexis, sutura profunda junctis, omninis in umbilici spatio conspicuis, centralibus ($1\frac{1}{2}$) levibus, politis, ceteris transversim oblique costulato-striatis, striis lateraliter atque infra tenuioribus seu obsoletis; ultimo anfractu supra quoddam prominente, prope medium altitudinis latissimo, ad umbilici marginem rotundate angulato, antice parum deflexo; apertura obliqua, semielliptica, lateraliter angustiore; peristomate exteriori parum dilatato, expanso et vix reflexo, prope medium unidentato; labio calloso.

Height of shell : transversal diameter (taken as 1.00)	...	...	...	0.35
Width of one whorl above : transversal diameter	...	...	...	0.21

A planorboid shell, consisting of five volutions, being laterally much narrowed, higher than broad, convex above and separated by a deeply impressed suture. All the whorls are visible in the space of the umbilicus, which is very large and the margins of which are, on the last whorl, slightly angulated. The greatest width of the whorls is near to, but still a little above, the middle; the central or embryonal whorls, comprising about one and a half volution, are slightly elevated above the somewhat immersed plane, shining and smooth; the others are covered above with pretty strong oblique striæ, which disappear below. The last whorl is not much deflected; aperture oblique, semi-elliptical and according to the size of the whorls higher than broad. The outer lip is expanded, strongly reflexed and inside, somewhat below the middle, provided with a short pointed tooth; the inner lip is callose, only partly visible on our specimen, the adherent rock preventing a view into the interior space. This makes it uncertain whether any other dentition is present or not. We must await other materials for this purpose; although, save a small portion of shell-surface near the mouth, our specimen is quite perfect.

This species, which is very like the South-European *H. (An.) anigyra*, Ziegler, is readily distinguished from the former by its narrower whorls and the less deflected anterior portion of the last.

Locality. N. E. and close to Alundanapooram, where the single figured specimen was found in sandstone.

Formation. Trichinopoly group.

II.—MACROCYCLIS, Beck. 1837.

Macro. testa planorboidea, depressa, late umbilicata, tenui: anfractibus celeriter crescentibus, ultimo prope aperturam sapius inflato atque deflexo; apertura subrotundata, peristomate tenui, marginibus labro approximatis antice paulum expanso atque reflexo.

As restricted to the depressed forms with a thin shell, the genus *Macrocyclus* seems to admit of tolerably good characteristics, although specimens, which are not in every way perfect, may be easily confounded with *Zonites* and others. H. and A. Adams quote besides *Macrocyclus* four subgenera, which in part include rather different forms with strong and consistent shells, thickened peristome and not umbilicated; it seems necessary, that these should be separated. The species of *Macrocyclus* are chiefly inhabitants of the East.

We notice one species from the South Indian cretaceous deposits, *M. carnatica*.

1. MACROCYCLIS CARNATICA, Stoliczka. Pl. I, Fig. 8.

M. testa planorbulari, tenui; spira immersa, late umbilicata; anfractibus quaternis, rotundatis, supra atque subtus omninis conspicuis, transversaliter minute striatis: striis supra fortioribus; apertura rotundata.

It is not without hesitation, that we venture to name specifically such an imperfect specimen as that figured. There seems to be no very serious objection as to its generic determination, although it exhibits some affinities to *Nanina*, which genus is, as Mr. W. Blanford informs me, by far more numerous represented throughout India, than has been usually supposed. The planorboid form, however, making all the whorls visible above and below is rather foreign to true *Naninae*. The specimen is accidentally so much injured by pressure, that it is not easy to determine the very exact shape in the roundness of the whorls, so as to fix the specific characters. The shell is quite depressed, coiled in nearly a regular plane with slightly immersed spire and with a perfectly open umbilicus, so as to make all the whorls visible below and above. The whorls are only four in number, increasing rapidly in width, and covered densely with transverse striae. These are oblique, somewhat stronger above than laterally and below, and slightly bent forward on the outer periphery. The whorls themselves are roundish, having their greatest width above the middle; and being apparently less convex above than below. The specimen has not got the aperture preserved, but it could have been only very slightly enlarged, as traces of the peristome were lost in cleaning out the specimen.

Locality. Near Veraghoor, in soft reddish coloured sandstone.

Formation. Arrialoor group.

Order, **PROSOBRANCHIA**, *Milne Edwards.*

CHARACTER.—*Gastropoda with conical or spiral shells, present even in the first stage of growth; larvæ with deciduous cephalic fins; gills placed in front of the heart; sexes distinct.**

• By far the larger number of the PROSOBRANCHIA are provided with an operculum, of which the structure and the position in the aperture are very important for all purposes of classification. Without exception, they are inhabitants of fresh or salt waters, although several species can, for a shorter or longer time, live outside of this medium in a moist atmosphere; and a few possess even an air-breathing organ, besides the gills.

The PROSOBRANCHIA are proportionally more numerous than any other order of the Gastropoda. This fact is equally true as regards the fossil, as the living species, which are, so far as our knowledge extends, nearly equal in number.†

Fossil species of PROSOBRANCHIA occur from the lower Silurian upwards through the whole series of the sedimentary deposits. Their solid shells usually admit of a good preservation in the fossil state; while the fact, that they are chiefly inhabitants of littoral waters of moderate depth, renders the study of this order of very great importance to the palæontologist. A knowledge of the PROSOBRANCHIAN fauna alone is sometimes sufficient to enable just conclusions to be drawn, as to the conditions, under which the materials, which once buried and now enclose these fossil shells, have been deposited.

We have already observed, that it appears desirable to separate from the order PROSOBRANCHIA, the POLYPLACOPHORA and the NEUROBRANCHIA. Excluding these, we shall have then to deal with the three next divisions, CTENOBRANCHIA, ASPIDOBANCHIA and CYCLOBRANCHIA, of which the second may rather be replaced by three others proposed by Gray—SCUTIBRANCHIA, SCHISMATOBANCHIA and DICRANOBANCHIA. The South Indian cretaceous rocks have yielded species in nearly all these divisions; and, according to the arrangement already adopted, we begin with the highest, the

Sub-order, Ctenobranchia.

CHARACTER.—*Prosobranchia with usually spiral shells, animal with the respiratory cavity on the neck containing one well-developed comb-like gill, rarely with a second gill in a more or less rudimentary state: the males have usually strongly developed external copulative organs.*

The CTENOBRANCHIA, in this sense, comprise the greatest portion of Cuvier's PECTINIBRANCHIA, and are generally divided into SIPHONOSTOMATA and HOLOSTOMATA. Although far from being a natural grouping, this division is unquestionably in many

* Some of the adherent genera, like *Tenagodus*, *Siliquarius*, *Vermetus* and others, are necessarily, from their mode of living, *Hermaphrodites*.

† Characteristics and descriptions of so-called new species of shells are published almost daily, but occasionally this is done in such a way, that it needs no serious apology from any conchologist, for having been unable to decipher the true character of some of the new species. Mere outlines of casts of usually richly ornamented shells certainly can be only of very limited local value. The publication merely of specific names for sake of priority is never justifiable.

respects preferable to that of PROBOSCIDIFERA, TOXIFERA, ROSTRIFERA, &c., because, if we depend on this single character of dentition, groups otherwise very closely allied are totally separated from each other.* To the palæontologist also, who has principally to deal with the shells only, and but very rarely with the animals, the first mentioned division is—no doubt only for the present—of far greater use, while he could scarcely take the desirable advantage of the other system in classifying his fossil remains.

Keferstein† distinguishes in the two divisions of the SIPHONOSTOMATA and HOLOSTOMATA a number of smaller groups, depending on the variations in the dentition of the radula, as the indefatigable labours of Drs. Gray, Troschel, Lowen, Mörch and others have made them known. It is certain, that these differences in the plaits or teeth of the radula, and their connection with the food and general living of the animal form a very important character in the classification: it would be quite an exception in this, as compared with the other classes, if they did not. Still so much remains to be done in this direction, as we have already noticed, that Keferstein's sub-divisions into TÆNIOGLOSSA, RACHIGLOSSA, &c., offer disadvantages similar to those presented by Adams' higher divisions. They widely separate families, which are closely allied in every respect save the dentition: so widely indeed, that even a partially natural arrangement from lower to more highly organized forms is unobtainable. We shall not enter further upon the discussion of these divisions depending on the dentition, but shall simply quote the families in what we believe to be their respective relations to each other, for which we shall endeavour to give more detailed proofs. We cannot pretend to call this arrangement more natural than many others. Our only reason for adopting it is, that in our present case of describing a *local cretaceous* fauna it appears to be more suitable for our purposes than that adopted by Keferstein (*loc. cit.*). As regards families and sub-families, which will be referred to, we must state in each individual case, in what sense these divisions are to be understood.

Tribe, Siphonostomata.

The CTENOBRANCHIA included in this tribe have usually a small head with either a proboscis or a long rostrum, and with a respiratory siphon of different lengths, sometimes represented by a siphonal fold only. The shells are convolute, involute, or coiled up into a conical spire. Depending on the development of the respiratory siphon, the aperture is either provided on the anterior termination with a canal, or is simply a little produced and notched. The operculum is sometimes wanting; but usually it is present, of horny or often of lamellose structure. Nearly all the species inhabit the sea and they are mostly carnivorous, feeding upon other mollusca or similar animals.

Geologically speaking, the SIPHONOSTOMATA are younger than the HOLOSTOMATA. Of the former, several families scarcely appear in deposits of date earlier than ter-

* This point has been most recently discussed again by Mr. Crosse (*Journal de Conchiliologie*, 3me. Ser. Vol. VI., p. 216, 1866), contesting the value of the dentition as the only or even principal base of classification in Mollusca.

† Bronn, *Klassen und Ordnungen des Thierreiches*, Vol. III, p. 1030, &c.

tiary, although this restriction to tertiary beds is not by any means so close as was formerly thought by palæontologists. In the Lias the SIPHONOSTOMATA constitute perhaps five per cent. of the Gastropoda, as compared with the HOLOSTOMATA. After that period, however, their number increases rapidly, and they soon overpower the latter to a large extent, being more numerous in the present seas also.

Under this tribe we shall describe the following families in the order here quoted. Some of the last named are by other conchologists transferred to the HOLOSTOMATA. Our reasons will be found stated with the families farther on.

- 1.—Family *ALATA* (comprising the *STROMBIDÆ* and *APORRHAIIDÆ*, or as proposed *STROMBINÆ*, *TEREBELLINÆ*, *APORRHAINÆ*).
2. „ *CYPRÆIDÆ* (*CYPRÆINÆ* and *OVULINÆ*).
3. „ *OLIVIDÆ* (*OLIVINÆ* and *ANCILLARINÆ*).
4. „ *DOLIIDÆ*.
5. „ *CASSIDIDÆ*.
6. „ *PLEUROTOMIDÆ* (*CLATHURELLINÆ*, *CLAVATULINÆ* and *PLEUROTOMINÆ*).
7. „ *CONIDÆ*.
8. „ *VOLUTIDÆ* (*MARGINELLINÆ*, *VOLUTINÆ*, *VOLUTOMITRINÆ*, *MITRINÆ*).
9. „ *FASCIOLARIDÆ*.
10. „ *MURICIDÆ* (*FULGURINÆ*, *FUSINÆ*, *MURICINÆ*).
11. „ *TRITONIDÆ*.
12. „ *COLUMBELLIDÆ*.
13. „ *BUCCINIDÆ* (*PHOSINÆ*, *NASINÆ*, *COMINELLINÆ*, *BUCCININÆ*).
14. „ *PURPURIDÆ*.
15. „ *TRICHOTROPIDÆ*.
16. „ *CANCELLARIDÆ*.
17. „ *TEREBRIDÆ*.
18. „ *PYRAMIDELLIDÆ*.
19. „ *CERITHIOPSIDÆ*.
20. „ *CERITHIIDÆ*.

I. Family. *ALATA*.

In taking advantage of this early name of Lamarck we do not intend to express by it more than the simple meaning the word itself indicates, namely, the general resemblance among the different forms of the shells in this family as regards the *expansion of the outer lip*. This was Lamarck's first idea, when establishing the family, and so far as any practical advantage is concerned in the determination of shells only, we believe, this general idea has not been yet superseded. Much, however, has since then been done in the examination of the animals, and, depending on the differences

which had been observed, two families were proposed: (a) *STROMBIDÆ*, with *Pterocera*, *Strombus* and *Rostellaria* as the chief genera; and (b) *APORRHAIIDÆ*, with *Aporrhais* and *Struthiolaria* (and probably *Priamus*), to which Gray adds *Trichotropis* and others (possibly better separated into a distinct group). Now viewing the similarities and the differences of the two families, we see them to be both *ROSTRIFERA* in the sense of Gray* (Guide to Mollusca, 1857, page 64), that is,

Siphonostomata with an annulated rostrum, subulate tentacles with the eyes on their outer side, and the teeth in seven series: three on either side being respectively of similar form. The mantle has its edges more or less expanded and lobed; the gills are pectinate; the operculum is annular, ovately elongated, rather thin and horny: the shell is fusiform, turritid or more ovate, the whorls internally compressed, narrow, and the outer lip always somewhat expanded in adult age.

The principal differences recorded in the anatomy of the animals, exist in the *locomotive organs and the tentacles*. In *Strombus*, *Pterocera*, *Rostellaria* (considering these genera in the old sense of Lamarck) the foot is divided into two parts, the posterior being more or less prolonged, slender, and bearing on its termination a claw-like operculum. The eyes are on prolonged peduncles, which have the tentacles on the internal side, that is to say, *morphologically*, the eye-peduncles and the tentacles seem to be grown together for a longer or shorter distance. The tentacles are often longer than the peduncles in *Rostellaria*, and nearly of equal size with them in *Pterocera*. In *Terebellum*, the forepart of the divided foot is very small and the hinder part very prominent and thick. The tentacles are usually said to be wanting, and the eyes to be on the ends of very long peduncles. Gray questions the first point, and it is, we think, very probable, that further researches will prove, that the tentacles are united, or grown together with the eye-pedicles throughout their entire length. This ought, at least, to be anticipated from a morphological point of view.

Aporrhais (*Chenopus*, Phill.) has the foot not divided, but somewhat compressed, and, although truncate in front, still somewhat produced; the eyes are sessile on very short peduncles, which are united with the very long subulate tentacles at the base only. Gray (teste Clark) says (Guide to Mollusca, page 75) the "*A. pelicani* creeps slowly; but the organs do *not appear adapted for progressive movement*. It is shy, and whether the shell is placed with the aperture upwards or "downwards, it does not usually commence creeping by pushing out the foot anteriorly "like other Gastropoda, but often twists the *long neck and foot to the caudal extremity*, "and there fixing it, with a sudden spring effects the turning of the shell." It is obvious, that this kind of movement is quite similar to that of *Pterocera* or *Strombus*, except that the divisions of *foot* and *caudal extremity* are not so evidently separated, as in those two groups of shells.

The foot of *Struthiolaria* is thick, small and oblong, more adapted for *fastening* than for creeping. The tentacles are of moderate length, and the eyes are on small bulgings outside near the base.

We see thus, that in the different alterations in the form of the foot and the eye-pedicles there is a transition and connection, rather than a strict separation. The

* This author proposes for the *Alata*, excluding *Aporrhais* and others, but including *Onustus* and *Phorus*, the name of *LEPTOPODA*, on account of the divided foot and the manner of moving about.

simple ovate foot of Struthiolaria is elongated, laterally compressed in Aporrhais, partially divided in Terebellum, and entirely divided into two separate lobes in Rostellaria, &c. The same might be said as regards the eyes; the *small bulgings* at the base of the tentacles of *Struthiolaria* are replaced by *short pedicles* in *Aporrhais*; these pedicles are *prolonged* (and probably united with the tentacles throughout their entire length) in *Terebellum*; while in *Rostellaria*, and others, they are usually *separated* from the tentacles near the termination, where the eyes are placed on the former. It is true, that other Gastropoda shew similar relation in the same points, and still are regarded as belonging to different families; but it must be remembered, that they do not agree in all the other similarly or more important characters, which we have previously noticed. Taking all these facts into consideration, it must be granted, that the structure of the animals does not lend itself very favorably to such a separation into two families as has been proposed by Adams, Gray and others. There would be far less difficulty experienced in this matter by accepting Adams' proposition of the two sub-families of *STROMBINÆ* and *TEREBELLINÆ*, and by adding to these his family *APORRHAIIDÆ* as a sub-family *APORRHAINÆ*, although I actually do not know, whether even this separation is necessarily called for. Supposing, however, that it were so, the distinctions between these sub-families would be those which I have specified regarding the foot and the eye-pedicles, while the other points of relation, quoted above, would form the character of the family.

These questions could all be easily settled, had we to deal with the living species only, but what is to be done with the immense number and great variety of fossil forms? To determine these with equal correctness, we ought to have distinctions in the form of the shell, equally characteristic with those we have noticed in the animals themselves. And if, as is often the case, we cannot determine with sufficient accuracy the genus, how difficult it must be to retain sub-families! Chenu consequently recognized only one family, the *STROMBIDÆ*, containing seven genera and a few sub-genera. In a general view this appears to be, provisionally, the best way: but the number of genera in living and fossil species must be enlarged, and those so-called sub-genera as much as possible avoided. At the same time, it cannot be questioned, that our object ought to be to endeavour to prove the existence of similarities and differences of the shells, in accordance with the results obtained from a careful examination of the animals, rather than to obliterate or ignore these on the supposition that they never existed before. It may be a very plausible conjecture, that these *distinctions did not exist at some remote period*, as some of our most able palæontologists are ready to believe, but we must first point out, at least approximately, what that period was. Nor can we ever establish this, until we carefully and gradually trace back these relations from the recent into the older formations. We shall recur to this point when speaking of *Alaria* and *Aporrhais*.

In treating of the different genera of the *ALATA*, it will not be necessary to go beyond what is justified by the material we have before us in describing our cretaceous fossils. To discuss these points fully would require a thorough knowledge of all the species both living and fossil. It is undoubted, that there are great difficulties in determining the distinctions of the sub-genera as proposed by H. and

A. Adams, but most probably any other would offer equal difficulties, and, at present, there seem to be no other possible means of distinction than some artificial one, as proposed by Adams and others.

Fossil forms of *ALATA* are first known, with full certainty, from the Lias (certainly middle, if not lower), and they continue numerous represented through all subsequent formations, but unfortunately are very rarely met with in good preservation. The cretaceous deposits are extremely rich in species belonging to this family. A nearly complete list of these species will be found in Pictet's "Paleontologie Suisse 3me. Scr." As to geographical distribution, the largest number is known from Europe, especially from the southern part. The American deposits are comparatively very poor in species of the *ALATA*, equally as in those of the *VOLUTIDÆ*. The fact is in accordance with the representation of these families at the present time.

The South Indian cretaceous deposits have yielded us a tolerably good number, represented by 15 species, which will be found described under five genera; *Pugnellus contortus*, Sow.; *P. granuliferus*, Stol.; *P. uncatu*s, Forb.: *Aporrhais Arrialoorensis*, Stol.; *Ap. securifera*, Forb.: *Alaria Parkinsoni*, Mant.; *Al. papilionacea*, Goldf.; *Al. glandina*, Stol.; *Al. acicularis*, Stol.; *Al. tegulata*, Stol.: *Rostellaria?* *palliata*, Forb.; *Pterodonta terebralis*, Stol.; *Pt. bulimoides*, Stol.; *Pt. nobilis*, Stol., and *Pt. Ootatoorensis*, Stol.

We commence the descriptions of the PROSOBRANCHIA with the family *ALATA* not because they are the most highly organized of this order, but rather on account of the difficulty of bringing them into the general scheme, if we began with any other family. Our only object here, as already stated, is to show the relations of the different families, genera and species, as composing a local fauna. It is true, that maturity reached at a later period and division of different functions on separate organs are generally signs of relatively higher organization; the locomotive organs are also higher developed than in most other families of Gastropoda. The eyes of the *ALATA* are nearly quite as perfect as those of Cephalopodes and Fishes, and the separation of tentacles and eye-peduncles, in a large number of species, could be looked at equally as a sign of higher organization, for this division is principally developed in the PULMONATA.

I.* PUGNELLUS, Conrad. 1860.

Pug. testa ovata, ultimo anfractu plus minusve involuta, crassa, strombiformi; apertura angustata, interne lævigata, marginibus continuis; labio callosissimo, postice accumulato atque sæpius spiram tegente; labro ad marginem crasso, posterius lobato: lobo plus minusve unciniforme prolongato; canali anteriori incurvo.

The genus *Pugnellus* was first proposed by Conrad (Journ. Acad. Nat. Sc. Phil. IV, p. 281) for four species, *P. densatus*, Con. from Mississippi, *P. tumidus*, Gabb, from Chili (subsequently described in Proc. Acad. Phil. for 1860, p. 197, Pl. 3, Fgs. 13 and 14), and the South Indian *Strombus uncatu*s and *contortus* of Forbes. Gabb has recently described two characteristic species from California (Pal. of Calif.

* Genera are numbered continuously in each order; the species in each genus.

1864) *P. hamulus* (l. cit. p. 124, Pl. 20, Fig. 81, and Pl. 18, Fig. 48) and *P. manubriatus* (l. cit. p. 125, Pl. 29, Fig. 229). This number is now increased by only one additional species from South India, *P. granuliferus*.

All the seven known cretaceous species agree in the characters mentioned above, and constitute a tolerably well defined small group. This must evidently be classed next to *Strombus*, forming in some respect a passage between the subgenera *Monodactylus* and *Gallinula*,* but differing from both in the very strong development of the callosity of the apertural margins and the *incurved* anterior canal. In all the three species, which we describe and of which we are in possession of good specimens, there is between the hook-like prolongation of the wing and the strong anterior notch a second slight insinuation of the margin, exactly similar to that of *Str. canarium* or *Str. japonicus*, which circumstance makes it almost impossible to separate *Pugnellus* far from these living species of *Strombus*.

The *Pug. uncatatus* appears first somewhat different from the other species of *Pugnellus*, and is in general habitus more allied to species attributed to *Gallinula*, than to any of the other forms known. In comparing, however, the shells closely it is seen, that the mode of growth of the outer lips is exactly the same, the transverse ribs being curved in the same way, as in *P. contortus*, excepting that the angle, where the margin is bent, is only strongly thickened and produced,† while in the other species it is prolonged into a hook-like lobe. Another difference is the pointed termination of the canal and the broad insinuosity of the outer lip next to it: the former is only a consequence of a smaller development of the callose margin, which however is not wanting, and is in character exactly the same as in the two other species; the latter is a somewhat more marked difference, and is to be found of exactly similar shape in a few *Rostellarie* and especially in *Hipporene* Montf., of which the eocene *Hipp. macroptera*, Lam. is considered as a type. A most noticeable fact is the great difference which exists between young or imperfect specimens of *Pugnellus* and those of full growth and perfect preservation, as may be seen by a comparison of the numerous figures on our Pl. III.

The genus is as yet restricted to the above-mentioned seven cretaceous species.

1. PUGNELLUS CONTORTUS, Sow. sp. Pl. III, Figs. 1—5.

1846. *Strombus contortus*, Sow., Forbes in Trans. Geol. Soc. Lond. VII, p. 129, Pl. 15, Fig. 9.

1850. *Colombellina contorta*, D'Orb. Prod. II, p. 231.

1860. *Strombus contortus* (not *contortus*), Sow. Journ. Acad. Nat. Sc. Philadelphia, IV, p. 284 (vide *Pugnellus*).

1861. *Pugnellus contortus*, Sow. sp. Gabb, in Proc. Amer. Phil. Soc., Vol. VIII, p. 128.

1864. *Columbellina contorta*, D'Orb. Pictet, Mat. p. l. Pal. Suisse, Foss. Ste. Croix, 3me. ser. p. 671.

Pug. testa elongate-ovata, spira brevi, acuminata, angulo 60°-65°; anfractibus senis, convexis, spiraliter obsolete-striatis, duobus ultimis transversaliter costulatis: costulis in ultimo anfractu flexuosis, antice versus evanescentibus, atque sæpius prope marginem exteriorem in medio convexitatis tuberculis terminantibus; apertura ovali,

* Is also a genus of birds.

† Since our figure on Pl. III was prepared, another larger and more complete specimen has been procured, on which the prolongation is much stronger.

angusta atque elongata, interne lævissima, marginibus conjunctis, callosissimis, partem ventralem testæ omnino tegentibus; labro antice valde insinuato, posterius lobato: lobo hamiformi, crasso, contorto, lateraliter compresso, acute terminanti, supra infraque canaliculato; labio crassissimo, callum ovalem elevatum formante; rostro callose-marginato, lato, interne canaliculato, intorto, supra sæpius incrustato seu prope marginem exteriorem subcanaliculato.

The general form of the shell is elliptical, somewhat elongated in the direction of the axis. There are usually six whorls present, forming a spire with an angle varying from 60 to 65 degrees; they are convex, the uppermost very distinctly and densely striated in a spiral direction; these striæ become afterwards nearly obsolete. On the penultimate whorl slight transversal costæ appear, which on the last whorl are flexuous, partly and gradually disappearing towards the anterior canal, while others placed nearer to the outer margin do the same, or terminate in more or less elevated tubercles, corresponding with the hook-like prolongation of the outer lip. On perfect specimens, the majority of which measure about 30 mm., the last whorl occupies usually a little more than three-fourths of the total height. The aperture is elongated-elliptical, being internally much narrowed by the callosity, which thickens and unites both margins. Some of our specimens exhibit on the callose mass round the aperture a kind of purple colouring, which partly seems to be original, resembling that of several living *STROMBIDÆ*. On the posterior part of the outer lips, between one-fourth and one-half the distance from the suture, the callose margin projects into a hook-like lobe, this being turned upwards, contorted towards the aperture, laterally more or less compressed, often so much as to form a sharp ridge on the ventral side; internally and externally it is canaliculated by slight furrows, which, however, often quite disappear under the coverings of the thickened lip. Near the anterior extremity the outer peristome is very deeply insinuated. The canal is slender in proportion to the last whorl; it is bounded like the outer peristome all round with a thick margin, curving inward at the same time; the internal furrow, which seems to have been produced by the elongated siphon, remains always distinct up to the termination, while the exterior one, which marks the place where the two thickened margins join, becomes often obliterated under the numerous layers of the callosity. The inner lip is exceedingly thick and forms on the ventral side an oval large mass of enamel-coating, the last or newest layers of this mass extend sometimes over the entire surface of the shell, with the exception of a small upper dorso-lateral portion.

There is not much variation in the form of the shell of this species, except that the last whorl is sometimes more, sometimes less inflated or gibbose. The hook-like lobe of the outer lip is occasionally less contorted, but somewhat more bent outside. The stronger or lesser development of the callosity causes all these differences and gives the shell often a totally different aspect. Specimens, on which the inner and outer callose mass has been lost, make quite the impression of being a *Fusus* or some allied genus. We have given figures of several of these forms and refer here to the explanations which accompany the plate (vide figs. 2—5).

Pug. manubriatus, Gabb (Palæontology of California, Vol. I, p. 125) is probably more allied to this species than it appears to be from Mr. Gabb's figure (loc. cit. Pl. 29, Fig. 229), and I would not in the least be surprised, if both were found to be identical. In Fig. 229 the traceable suture shews, that the callosity was not present in its entire thickness, and the want of the same near the anterior extremity seems to prove, that this has been partly injured. We possess several specimens with such diminished thickness of the inner callosity, and with the incurved termination of the anterior canal broken away; in this state our specimens do not exhibit any very remarkable distinctions from Gabb's figure.

Localities. N. of Alundauapooram (very common), Kolakonuttom, Serdamungalum, Anapaudy, Monglepaudy, Seraganoor, E. of Illpagoody in Trichinopoly district.

Formation. Trichinopoly group, of which the described species seems to be a very characteristic fossil.

2. PUGNELLUS GRANULIFERUS, *Stoliczka*. Pl. III, Figs. 6—8.

Pug. testa ovata, crassa, spira brevis, angulo circiter 75°; anfractibus quinque vel senis, convexis, transversaliter granulato-costatis, una serie granorum crassiorum prope marginem suturalem sejuncta, spira vix quintam partem totius altitudinis occupante; anfractu ultimo posterior transversaliter oblique costulato, ad medium spiraliter granulato, antice sublevigato et multo angustiore; apertura ovali, elongata, antice angustata, interne levigata, callosissima, marginibus callositate conjunctis; labro posteriori prope medium uncinato: unco crasso, contorto, posticè extenso, lateraliter compresso, infra plus minusve acuto, interne atque externe canaliculato; labro antico profunde insinuato; rostro prolongato, crasso, lente exterius contorto, terminatione incurvo, intus canaliculato, extus medio impresso seu furcato: impressione sæpius callositate fere obsoleta; labio callosissimo, accumulato, spiram fere totam tegente.

As regards the form of the shell, this species agrees in every way with that of *Pug. contortus*, to the description of which we refer in its greater details. The differences consist in size and ornamentation.

All the specimens of *Pug. granuliferus* are even in the first stage of age thicker and more ventricose, and they grow to a much greater size, the usual height in the direction of the spiral axis being 40 mm., and the width including the hook-like lobe somewhat more than 30 mm. The aperture is anteriorly a little narrower, the canal somewhat more contorted and the insinuation in front of the lobe deeper, as in *P. contortus*.

The ornamentation consists from the first volutions in oblique transverse costæ and in spiral sulcations, which sometimes produce a more or less regular granulation. One row of such coarse granule is always separated near the suture. To this uppermost row follow transverse ribs, which occasionally are represented by elongated roundish tubercles only. On the last whorl a few slight sulcations cross the ribs, which at about one-fourth or usually one-fifth of the distance from the suture, as compared with the total height of this volution, are cut off by deep spiral sulci, so as to form six to ten rows of smaller or larger, rounded or flat, and more or less

isolated tubercles or granulae. On the anterior and much thinner portion of the last whorl, which is produced into the canal, the surface is usually so much covered with the callosity, that it appears quite, or to a great extent, smooth.

It would not be easy to find two forms, which remind one more of merely sexual differences, than the *Pug. contortus* and *granuliferus* and still, if the differences are so remarkable and constant, we cannot do else, than distinguish them by specific names. In the description of the former species, I have remarked, that on the first whorls spiral striation or sulcation is quite distinctly traceable, and that it becomes more or less obsolete on the following and especially on the last whorl; in all cases, it is at least indicated: if we wanted to go a little further, we could justly say, it is merely exaggerated in some abnormal specimens, which are here noticed under *P. granuliferus*. Quoy and Gaimard, Soutelet and several other conchologists have noticed, that the female shells of Mollusca exceed those of the male sex very often in size, being usually more inflated or ventricose. It appears to me more likely, that we have to deal here with such a difference of forms, rather than with two animals actually different as regard species.

For imperfect specimens the reader is referred to the explanation of Figs. 6 and 7, Pl. III.

Localities. Kolakonuttom, Andoor, N. and S. of Serdamungalum, S. E. of Anapady, in the Trichinopoly group; W. of Illpagoody, Shillpagoody and Veraghoor, in the Arrialoor group. In all these localities of the Trichinopoly district *Pug. granuliferus* is not very common and comparatively much rarer than *Pug. contortus*, of which about eight specimens occur to one of the former. The quotation of the Arrialoor group is probably not so very important, the localities being chiefly near the boundary of these two groups, and on the other hand Mr. Blanford himself states, that their separation is, in the southern portion of the Trichinopoly district, generally uncertain.

Formation. Trichinopoly and Arrialoor groups.

3. PUGNELLUS UNCATUS, Forbes, sp. Pl. III, Figs. 9—13.

- 1846. *Strombus uncatus*, Forbes in Trans. Geol. Soc. Lond. VII., p. 129, Pl. 13, Fig. 16.
- 1847. *Strombus semicostatus*, D'Orbigny, Voy. Astrolabe et Zélée, Paléont. Pl. 2, Fig. 38.
- 1850. *Colombellina uncata*, D'Orbigny, Prod. II, p. 231.
- 1860. *Strombus uncatus* (Forb.) Conrad, Journ. Acad. Nat. Sc. Phil. IV. p. 284 (vide Pugnellus).
- 1861. *Pugnellus uncatus*, Forb. sp. Gabb, in Proc. Am. Philo. Soc. VIII. p. 128.
- 1864. *Columbellina uncata* (D'Orb.) Pictet, Mém. p. l. Paléont. Suisse, Foss. Ste. Croix. 3me. ser. p. 67.

Pug. testa ovate-ventricosa, antice atque postice attenuata, spira quartam partem totius altitudinis testæ elevata, angulo 65°—75°; anfractibus quinque vel senis, convexis, sutura impressa junctis, prioribus spiraliter dense-striatis, striis in ultimo anfractu obsoletis; ultimo anfractu transversaliter costato: costis flexuosis, antice evanescentibus. Apertura angustata, ovali, postice sub-rotundata, antice acuta, intus lævigata, callosa; labro incrassato, in alam brevem atque rotundatam seu angulatam postice extenso, extus lamellosa, parum reflexo, intus lævi, antice atque postice insinuato; labio crasso, calloso, in ætate adulta infra atque lateraliter spiram incrassante; rostro extus contorto, acute terminanti, incurvo, intus canaliculato, callositate marginali tenui instructo.

Shell ovate, pointed at each end, consisting of five or six convex volutions, the last of which is the most ventricose occupying about three-fourths of the total height of the shell. The upper whorls are densely covered with fine spiral striæ, which do not seem to increase in number with the breadth of the whorls, but they become gradually more distant and are nearly obsolete on the last whorl. This one exhibits transversally strong flexuous ribs, originating at the suture and disappearing gradually on the anterior portion, where they are often replaced by striæ of growth only, and in which case the spiral striation assumes again a little more distinctness. The outer lip is much thickened, expanded into a roundish or angulated wing, inside smooth and somewhat reflected, having a sharp margin; exteriorly it shews a kind of lamellar structure; anteriorly and posteriorly it is insinuated. The posterior insinuation is rather deep, but the exterior margin is simply rounded or angulated and always somewhat more thickened, not, however, prolonged into a hook, as in the two other species of *Pugnellus*. The inner lip is in both equally thick, callose, covering the preceding whorl nearly totally (Fig. 10). The canal is thin, contorted, terminating with a sharp point and bent inwards. The callosity of both margins extends over it, but it becomes much thinner here, and covers chiefly the exterior surface. This pointed form of the canal, and the want of a hook-like lobe on the outer lip, combined with the slight but broad anterior emargination are the principal and characteristic distinctions of this species from the two others. Specimens devoid of the callose covering and of the wing are nearly smooth and resemble a *Buccinum*, as Prof. Forbes remarks, or still more a *Phasianella*.

Even the imperfect and cast specimens of this species are easily distinguished from those of the other species by their gradual, not abrupt tapering or contraction towards the anterior termination of the canal.

Localities. W. of Parchairy and W. of Kullygoody; E. of Anapaudy and near Arrialoor. At all these localities the species is not very common; the first three are in the Trichinopoly, the fourth in the Arrialoor group, of the Trichinopoly district.

Formation. Trichinopoly and Arrialoor groups.

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II. APORRHAIIS, *du Costa*. 1778.

III. ALARIA, *Morr. & Lyc.* 1854.

IV. ROSTELLARIA, *Lamk.* 1799.

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and allied genera.

By far the greater number of conchologists agree in the application of the name *Rostellaria* to the fusiform, chiefly smooth, species with a long anterior and short posterior canal, and a moderately expanded, entire or slightly digitated wing, having near the canal one distinct sinuation. The *R. rectirostris* and *fuscus* are known as the best examples. The cancellated species with a short canal have been partly separated by Agassiz as *Rimella*, and there are numerous fossil tertiary and cretaceous forms, which belong to this group. The fossil species with a very large wing and a short pointed canal, as *R. macroptera* and others, belong to *Hippocrene*, Montf.

Conrad established for a few North American cocene species another group under the name of *Calyptraphorus* (vide Journ. Acad. Nat. Sc. Phil., Vol. IV, Pl. 47, Figs. 21 and 29). The shell is very slightly ornamented, as in true *Rostellaria*, the spire nearly totally enveloped in a callose mass, the wing small and simple, the anterior canal straight and of moderate length. *Calyptraphorus* would seem to connect *Rostellaria* and *Hippocrene*, agreeing with the former in the form of the wing and canal, and with the latter in the large development of the callosity. Gabb (in his Catalogue, Proc. American Phil. Soc. VIII, p. 98) refers the Indian cretaceous *Rost. palliata* of Forbes to *Calyptraphorus*. This does not seem, however, to be fully justified for the present. Mr. Conrad does not show in his figures of *Calyptraphorus* any posterior canaliculation on the aperture, while in our species this is very distinctly marked. This character is essential to all species of *Rostellaria*, being dependent upon the existence of a certain filamentous organ, somewhat similar to that of *Oliva* and allied genera. We shall notice subsequently under the description of the species, that the aperture of *R. palliata*, Forbes, appears to have been anteriorly only effuse or notched, and if any canal was really present, it must have been very short indeed. The only very similar form, that we have been able to trace, is the *Rostellaria laevigata*, Melleville (Ann. des sc. geologiques etc. par Riviere, II. 1843. p. 117, Pl. X, Figs. 10—11). In Melleville's original figure there is apparently no sign of incompleteness of the specimen observable, although this seems to have been rather considerable, when we compare with it Deshayes' figure in his last publication (Anim. s. vert. d. bassin de Paris, III, p. 460, Pl. 90, Figs. 5 and 6). M. Deshayes' representations of the single complete specimen, which he had obtained, named *R. sublaevigata*, D'Orb.* shews, that the species possessed a short anterior canal. In any case, whether our cretaceous form had only an anterior notch or emargination (as is supposed in our restored figure), similar to that of many *Pterodonta*, or whether it had a short canal, which is almost quite as probable, there is certainly for the present no sufficient reason to separate the species generically from the smooth *Rostellaria*. Better materials will of course settle this little difference very easily.

A number of fossil species, which are generally described under the three names prefixed to these notes, offer moreover a far greater difficulty than the allied forms

* It seems impossible to trace this name of D'Orbigny from the "Prodrome," namely, from the edition (in three volumes) bearing date 1850-1852, and I am not aware of any other. It is true, that Sowerby designed in 1832 a young shell of *Alaria* (*Rostellaria*) *costata* (vide Stoliczka in Sitzungsab. Akad. Wien. 1865, Vol. LII, Revis. p. 66), with the name *R. laevigata*. This name was evidently selected first by Sowerby and communicated to Sedgwick and Murchison, who published the same in the list accompanying their paper on the "Structure of the Eastern Alps;" vide Trans. Geol. Soc. Lond. 2d. Ser. vol. IV, p. 419. Subsequently Mr. Sowerby changed, for some reason or other, this name into *R. laeviuscula*, which is to be found in the "Explanation of the plates" attached to the same volume of the Transactions. So far as I can make out, Mr. D'Orbigny was acquainted only with the second name of Sowerby and knew in the Prodrome no other, than Melleville's (Deshayes ?!) *R. laevigata*. I have stated elsewhere, that Sowerby's names *R. laevigata* and *laeviuscula* have no signification in reality, and as the species, of which they are fragments, is not a *Rostellaria*, in the sense in which it appears desirable to restrict the genus, I do not know whether the change of Melleville's original *R. laevigata* is at all necessary. Certainly the reference, which Deshayes quotes in his "Paris fossils" p. 460,—1850. Prod. de pal. t. II, p. 315, No. 322,—is not to be found in that place.

known as *Rostellaria*.* Excluding *Pterocera*, to which usually the more inflated shells with a broad digitate wing are referred, the remainder of the Liassic and Jurassic species of the *ALATA* are generally, since the publication of Morris and Lycett's "Fossils of the great oolite," described under the generic name *Alaria*. The most recent publication on this point is the supplement to D'Orbigny's 'Paléontologie Française,' Tom. III. Gastropoda. Piette, who undertook the description of the SIPHONOSTOMATA, restricts the genus *Alaria* to those species which have no posterior canal and generally a narrow wing: *Chenopus* (*Aporrhais*) to others with a posterior canal and broader and less digitate wing. Pictet very justly remarks (Mat. p. l. Pal. Suisse, 3me. Ser. p. 588 etc.), that it is impossible to keep up this kind of distinction; but he acknowledges certain peculiarities in the Jurassic species only, and to these he would restrict the name *Alaria*, placing all the other cretaceous forms under *Aporrhais*. This, however, cannot stand, as we shall have occasion to notice further on, although we fully agree with Pictet's views in general, and have, therefore, endeavoured to shew the similarity in the fossil forms by adopting the family name *ALATA*.

I have myself referred the largest number of the species of the same group, from the Alpine Gosau-formation to *Alaria*†. This passing from one extreme to the other, and the widely differing controversies of different writers, are sufficient signs of the very unsettled state of the question, as to what genera should be accepted. In the following description of the species, I have partially adopted Piette's views, but at the same time I have endeavoured to combine with the characters, mentioned by the French author, others, which appear of great importance.

It is well known that young specimens of *A. pes-pellicani* have no posterior canal, and that this becomes developed in fully grown specimens only. But if at the same time we examine the shell of the species we have just noticed, we find that the callosity, which is secreted in the aperture by the mantle, is totally different from what we see in *Rostellaria*. The body of the animal is very thin, depressed, and it is only the margin of the mantle which expands. The anterior canal is in no way different from the other digitation of the wing, and the callosity does not extend upon the upper surface of the wing, but forms exteriorly a sharp edge. The inner lip is strongly thickened, accumulated, not extending beyond the under surface of the shell, while, in *Rostellaria*, the callosity appears to be more equally distributed in thin layers over the greater portion of the spire, and not uncommonly over the whole shell. Another very marked distinction is the length and the interior space of

* It is scarcely necessary to notice the unjustifiable application of names such as *Gladius*, or even *Fusus*, to *Rostellaria*. Undoubtedly it is not right to ignore old names for the sole reason that they had been neglected by subsequent authors. But when these old names have been chiefly applied in a certain loose sense, and never had afterwards any certain restricted signification, they are and must be justly rejected. Such is the case with *Gladius* and *Fusus*, but not with *Aporrhais*, which had a strict application before *Chenopus* was introduced, probably only because *A. pes-pellicani* cannot easily be mistaken for any other living species. Gabb in his Catalogue (loc. cit. p. 109) hastily referred all the cretaceous species, which had been described under *Rostellaria* to *Gladius*, but in his most recent publication (Palaeontology of California, p. 124) he re-adopts, in accordance with the generally received views, *Rostellaria* again. Such uncalled for changes are not to the benefit of science.

† Sitz. Akad. Wien. 1865, Bd. II, Revision etc. p. 65.

the canal. I have consequently referred only those species, in which I have been able to observe such marked callosity—differences in the aperture and the canal to *Aporrhais*, and have left the others provisionally in *Alaria*. I am quite aware of the weakness of this point; still I cannot think it right to consider all distinction as *à priori* impossible, and thence to unite all under the genus *Aporrhais*, as has been done by Professor Pictet. My chief reason for not doing so, is my fear lest by this system all chance of progress in a classificatory knowledge of the numerous fossil *ALATA* should be cut off. It is, for example, difficult to understand, that species like *R. carinata*, Mant. or *Anchura abrupta*, Conr. ought to be brought into closer alliance with *Aporrhais*, than with *Rostellaria*. They differ from both, but I should say more from the former than from the latter. The genus *Alaria* must be in some way restricted, and cannot be retained either in the sense in which it was introduced by Morris and Lycett, nor as lately commented on by Piette. Chenu classed *Alaria* with *Pterocera*, but very different forms appear to be represented in it, allied to *Rostellaria*, *Pterocera* and *Aporrhais*. Deshayes in the last issue of the Coq. foss. de Paris, Tom. III. p. 438 also entertains the opinion, that *Alaria* (certainly in part) is more allied to *Rostellaria* than to *Aporrhais* (*Chenopus*).

I have repeatedly gone over all the fossil species known to me, and it is, I think, impossible to come at the present to any satisfactory arrangement. Much may be expected from good materials, since scarcely one-tenth of the species, known up to the present, have been obtained in a perfect condition. Still, for a long time to come, nothing but an artificial division will answer; I mean, a division based more upon one or other single character, than upon the totality of the structure and form of the shells. The following may serve as an attempt, at least in one direction, though I confess I myself look at it for the present partially hopeless of success, and I do not like, therefore, to carry it out.

These remarks refer principally to the forms, which have been formerly noted as *Aporrhais* or *Rostellaria*. The relations between the latter genus and *Pterodonta* will be noted subsequently in detail.

1st.—To restrict the name *Alaria* to the species with a simple undivided and narrow wing, as the Jurassic *Al. humus*, Desh. and *Al. rhinoceros*, Piette and Desh.

2nd.—Species, which have the exterior termination of the wing extended in two opposite directions (as *Rost. carinata*, Mant.), and possess a long anterior canal, could form a small group, designated by Conrad *Anchura*.*

3rd.—Broad winged shells with only a single point to the posterior external termination, as *Rost. Orbignyana*, Pict., or *Rost. papilionacea*, Goldf. might be distinguished under a separate name.

* Jour. Acad. Nat. Sci. Philad. IV, 284. Pl. 47, Fig. 1. Conrad's characteristics are very closely specified and restricted to the single species, which he describes.

All these three forms are generally ornamented with transverse ribs.

4th.—Species with slightly dilated wing, soon dividing into two or three long extremities, carinated and usually spirally striated whorls et cet.—as the long known *Al. myurus*, Desh. or *Al. lævigata*, Morris, might be referred to *Tessarolax*, Gabb.*

5th.—To retain under *Aporrhais* only those species, which have a broad dilated wing from the base, terminating exteriorly in as many points, as there are keels on the exterior side of the wing, which ought in all cases to extend to the exterior margin of the wing, as in *Ap. Dupiniana*, D'Orb. or *Ap. (Chenopus) atractoides*, Desh.

6th.—The Jurassic *Diarthema paradoxa*, Desh. forms a separate genus, somewhat allied to *Ranella*.

7th.—*Spinigera* of D'Orbigny ought probably to be classed here better than with *Ranella*.

The genus *Eustoma*, Piette, will be mentioned hereafter in the *CERITHIIDÆ*; its position is at present uncertain.

Through a limitation of *Aporrhais* in this way we evidently come into *Pterocera* and *Strombus*, when such a review becomes nearly exhausted, and would again suggest considerable alterations.

I have already stated, that it is not through the living species of *Strombus* and *Pterocera*, that these great obstacles are produced, but through the large number of the fossil so-called *Pterocera*, which give so little hope of an early and successful classification. The difficulties, however, become insurmountable, should such an unnecessary separation be acknowledged, as has been proposed by the creation of the families *APORRHAIIDÆ* and *STROMBIDÆ*. The length of the canal or mantle-fold cannot form a very important distinction, for the canal is quite as short in many true *STROMBIDÆ*, as it is in *Aporrhais* or *Struthiolaria*. The form of the rostrum in the animals of the two last named genera is no doubt quite similar to that of many *CERITHIIDÆ*, but the different genera of this family show also a similarly considerable variation in the form of this organ (see *Vertagus*, *Cerithium*, *Teliscopium*, *Triphoris* and *Cerithidea*), if perhaps not to the same extent, as the *ALATA*. H. and A. Adams state, (loc. cit. p. 281) that especially the fossil forms indicate strong affinities of *Aporrhais* with *Cerithium*; I confess, that I am not aware of any fossil forms such as would support a separation of this kind. Where affinities have been pronounced as existing between the two genera, it was, and still remains to a great extent, to be shewn, whether these had not arisen merely from the incompleteness of the fossil species of the *ALATA*. Many of the older secondary species of *CERITHIIDÆ* exhibit great relations to some species of the *TROCHIDÆ* and many *Chemnitzia*, but they cannot be generally mistaken for *Aporrhais* or other allied genera.

* Palæont. of California, 1864, I, 126, Pl. 20, Fig. 82.

II. APORRHAIIS, *da Costa*, 1778.1. APORRHAIIS ARRIALOORENSIS, *Stoliczka*. Pl. II, Fig. 1.

Ap. testa acute-ovata, anfractibus septenis, convexis, minute cancellatis; ultimo spira altiore, supra medium acute-, infra sub-carinato, spiraliter striato; apertura angustata; canali anteriore brevi, posteriore spiræ usque ad apicem decurrente; labro parum expanso, digitato (?), ad marginem crassiore, reflexo, extus acuto.

Shell oval, pointed on each end, composed of seven convex volutions, which are ornamented with spiral and slightly curved transversal striæ, the latter being somewhat stronger. The last whorl is higher than the spira, inflated and provided above the middle with a stronger and below it with a smaller keel, both of which form probably small points or digitations on the outer margin of the aperture; spiral striæ are numerous above and below the keels, between them only one is present. The anterior canal is short pointed, much thickened internally and slightly bent inwards at the point of termination. The aperture is very much narrowed by the thickness of the lips, as is generally the case in other species of this genus. The outer lip is not much expanded, terminating in one or more probably in two points; its margin is somewhat reflected, showing a slight sinus near the anterior canal; the posterior canal is prolonged up to the apex of the spire being annexed to the previous volutions.

Locality. Comarapolliam near Ootacod: the figured specimen is unique, and unfortunately little portions of the exterior margin of the aperture have been lost in preparation; the extent of the wing has been restored in its probable shape.

Formation. Arrialoor group.

2. APORRHAIIS SECURIFERA, *Forb. sp.* Pl. II, Figs. 2—4.

1846. *Rostellaria securifera*, Forbes, Trans. Geol. Soc. Lond. VII., p. 128, Pl. 13, Fig. 17.

1850. „ „ D'Orb.; 1861, *Gladius* id, Gabb; 1864, *Aporrhais* id, Pict. et Camp.

Ap. testa spira elongata, turrata, anfractibus numerosis, ad medium subangulatis, convexis, costulis transversalibus spiralibusque ornatisisque plus minusve granulosis; ultimo ad medium carinato, subinflato; labro in alam angustam uncinatam, postice curvatam extenso; apertura angusta, interne callosissima, lævigata; labio accumulato, crasso; canali antico atque postico brevi.

Spiral angle 25°—28°, sutural angle 8°—10°.

A turreted shell consisting of numerous whorls, which are more constricted on the upper than on the lower suture and ornamented with transverse and spiral ribbings. On the uppermost whorls the transverse ribs are usually much stronger, being slightly curved and crossed by fine spiral elevated striæ. These latter increase on the next whorls much more rapidly in strength than the former, and being elevated on crossing these they easily produce the appearance of continued rows of tubercles. When at the same time the transversal ribs become somewhat obliterate, these tubercles appear more isolated. There is nearly every possible transition to be observed between the continued and smooth ribs and single isolated rounded tubercles. The

number of transverse ribs is nearly constant, 15 in one volution, and that of the spiral, 7 or 8 on one whorl. Of the latter the upper three are more distant from each other and usually stronger, the lower 4—5 are thinner and much more closely placed to each other. There are sometimes exceptional cases met with, in which the lower striae are of equal strength with the upper (vide Fig. 3), or where the upper become even nearly obsolete, while the lower continue in their strength. When the shell surface is completely preserved, it is also covered with a very fine spiral striation.

The last whorl is somewhat inflated, in circumference triangularly gibbose and near the middle provided with a strong keel, which is tuberculose or nodulose: the nodules being produced by a stronger development of the transverse ribs; the keel continues, however, smooth on the wing-like prolongation of the outer lip. The aperture is considerably narrowed from the great callosity of the interior of the lips. The posterior canal is short, not extending usually beyond the antepenultimate whorl. In none of our specimens is the anterior canal preserved, it could not, however, have been long, and is probably complete in the figure given by Professor Forbes (loc. cit.), according to which we have restored it in outline in our Fig. 2, Pl. II. The wing is simple and narrow, turned upwards or posteriorly, internally canaliculated in its entire length and externally keeled near the upper, or concave margin. Between the wing and the anterior canal there are two insinuations of the margin, being separated by a small pointed prolongation of the same, so as to form a second small wing.

There cannot be a question, that Professor Forbes' figure, referred to above, represents only a fragment of a very large specimen, being mostly devoid of shell-surface (vide Fig. 4, Pl. II.). We have observed, that on similar large specimens the ornamentation often becomes near the aperture more or less obliterate, although it does not disappear without leaving traces of roundish tubercles. Prof. Forbes says, that the surface appears to have been quite smooth, but that it was not, is distinctly seen in his figure, which shews the three upper spiral striae as impressions on the interior side of the uppermost whorl.

Ap. securifera bears, as regards ornamentation and general form, a great resemblance to *Rost. Requieniana* (D'Orb. Pal. Franç. Ter. cret. II. p. 293, Pl. 209, Figs. 3 and 4). The spiral striation of the latter does not seem to have been well preserved on the specimens, from which the figure was restored; but that it could not have been wanting on the lower or anterior portion of the younger whorls is sufficiently proved by its existence on the last. It is difficult to say, until actual specimens have been compared, that they are identical, but certainly it appears very probable, that they do not belong to actually different species. The *Ap. granulata*, Sow. sp. (Zekeli, Gosau-Gastropoda, Pl. 12, Figs. 3, 4, 7 and 8: *Alaria* id. Stoliczka, Sitzungsab. Akad. Wien. Vol. LII, p. 67) differs merely by its posterior canal being prolonged to the apex and by some of the transversal ribs being at intervals considerably thickened. It belongs undoubtedly to the same group of species of *Aporrhais*.

Localities. Kolakonuttom, N. of Serdamungalum, N. of Alundanapooram, E. of Anapady, Andoor, N. E. of Koloture; Olapady, Arrialoor and Karapady.

Formations. Trichinopoly and Arriallor groups, only the three last named localities refer to the latter; the species is far more frequent in the first named group.

III. ALARIA, *Morris & Lycett*, 1854.

1. ALARIA PARKINSONI, *Mantell*, Pl. II, Figs. 5—8.

1864. *Aporrhais Parkinsoni*, Mantell. Pictet Mat. p. I., Pal. Suisse, 3me. ser. Foss. Ste. Croix, 2d. pt. p. 604. with synonyms and references to other authors.

Al. testa elongata, turrita; anfractibus numerosis convexis, primis 3—4 levigatis, cæteris transversaliter costulatis, spiraliter striatis: costulis circiter 18 in uno circuitu, parum curvatis atque obliquis, utrinque attenuatis, nonnullis rectis, varices quoddam fortiores representantibus, in ultimo anfractu paucioribus atque prope marginem exteriorem gradatim evanescentibus; striis numerosissimis, nonnullis prope suturam posteriorem fortioribus atque distantioribus; ultimo anfractu subinflato, gibboso; rostro moderate-longo, acuto; labio calloso, partem inferiorem ultimi anfractus legente; labro alato; ala lata, brevi, postice intus ad anfractum antepenultimum decurrente, ad marginem exteriorem acute uncinata atque in utroque latere unci insinuata, antice ad peripheriam angulata atque rursus late insinuata.

Spiral angle 28° — 32° , sutural angle 8° — 9° .

Pictet gave in his 'Paléontologie Suisse,' such a thorough critical examination of this species, that it is scarcely necessary to add any thing to the knowledge of its literature. A comparison of our figures with those already existing will shew, that the form of the shell and of the whorls, together with their ornamentation and the wing, are in every way so exactly identical with the European species, that no remarkable difference can be traced out.

The first three or four, probably embryonal, whorls are quite smooth, with a polished surface (Fig. 7). They seem to become filled out by growth with a solid mass of shell-substance, inasmuch as they disappear altogether on the cast of the shell (vide Fig. 5). The perfect shell seems to have been covered with a thin coat of callose mass, obliterating somewhat the finer ornamentation on the surface. The last whorl including the anterior canal is about one-fourth longer than the spire (vide Fig. 5). As regards the wing, our specimens, so far as they are complete in this point, resemble much more the English figure in "Geol. Trans. IV., Pl. XVIII., Fig. 24," than that of Pictet in his 'Gres verts;' the differences arise probably much more from the imperfectness of the specimens, than from being actual variations, although both may be accounted for, especially as in all the species of the *ALATA* the form of the wing so much differs with their age. It would no doubt be very interesting to know whether such a variation does exist, and whether it is to that amount admissible within the limits of the species. If it be, then a very close comparison appears necessary of the specimens known as *R. Parkinsoni* with *R. Reussi*, Geinitz. The figures given by Reuss and that of Woodward (Geologist 1861? Pl. XI. Fig. 1) show the only difference in the anterior margin of the wing. I need scarcely repeat, that the wing in *Pterocera*, *Rostellaria* and others attains its perfectness only very

gradually, and that it does not develop itself equally in different specimens of even the same species. Some specimens of *Strombus* or *Pterocera* have their wing perfect, although being scarcely of half the size of others which have it not. I rather think it probable, that *R. Reussi* is not different from *R. Parkinsoni*.

Localities. Neighbourhood of Odium and Moraviatoor, S. of Serdamungalum, S. E. of Monglepaudy, in Trichinopoly district.

Formations. Ootatoor and Trichinopoly groups.

The references as to the occurrence of the species in Europe agree as to its belonging to the middle cretaceous strata, specially the Gault.

2. ALARIA PAPILIONACEA, Goldfuss, *sp.* Pl. II., Figs. 9 and 10.

1844. *Rostellaria papilionacea*, Goldfuss, III Petr. Germ. Gast. p. 18, Pl. 170, Fig. 8.

1847-1862. „ „ Reuss, Geinitz, Muller, Pictet, etc.

Al. testa elongata, conica; anfractibus 8—9, subconvexis, transversim costatis, ad suturam posteriorem spiraliter numerosissime striatis, ultimo anfractu spira longiore; rostro brevi; ala simplici, crassa, postice ad marginem interiorem anfractui penultimo adhærente, ad exteriorem subacuta, antice rotundata, parum insinuata.

Spiral angle 32°—38°, sutural angle generally 8°.

In Goldfuss' original figure of this species the wing is more sinuous on its anterior margin, but all subsequent authors agree, that this sinuosity is not so strong, and it appears, that the slightly different shape has been produced by pressure injuring the specimen. Our specimens as regards form are perfectly identical with the figures of Reuss (Böhm. Kreidef. 1845, Pl. 9, Fig. 6) and Geinitz (Char. Pl. 18, Fig. 8, and Verst. v. Kieslingswalde Pl. 1, Fig. 11). The specimens from the German Quadermergel and Pläner are mostly casts, and their whorls appear, therefore, to be much more convex than they actually are. Well preserved specimens of *Al. papilionacea*, when compared with *Al. Parkinsoni*, appear to have a much thicker shell, smaller number of ribs in one volution (12—16), and usually a shorter spire with a larger angle. The surface is usually smooth, covered with a layer of callosity, except on the uppermost whorls, which are finely striated. The striae near the upper or posterior suture are also a little stronger, but they are much more numerous than in *Al. Parkinsoni*. The transverse ribs are distant on the last whorl, forming elongated tubercles on the convexity and being obsolete near the suture and on the wing itself.

Localities. E. of Anapady, Andoor, Coonum, Koloture, Kolakonuttom, Shutanure, N. of Serdamungalum, N. of Alundanapooram; N. of Karapady, Permapolliam, S. W. of Nulloor, in Trichinopoly district.

Formations. Trichinopoly and Arriallor groups; to the latter the three last named localities belong, and the specimens procured are only very few in number.

The species is pretty common in Europe all through the middle cretaceous beds of Northern Germany, from Lemberg in Galizia into Hanover. It has not, I believe, been recorded from any place south of the Alps, nor from England.

3. *ALARIA GLANDINA*, *Stoliczka*. Pl. II, Figs. 14 and 15.

Al. testa acute-elongata, anfractibus numerosis, ad suturam posteriorem sensim constrictis, lævigatis, transversaliter costulatis: costulis acutis, obliquis, 8—12 in uno circuitu; spira ultimo anfractu (sine canali) longiore; ala simplici, falcata, postice ad peripheriam uncinata, acuta, interne anfractui penultimo affixa.

Spiral angle 32° — 35° , sutural angle 8° .

The whorls are rather numerous in this species, when compared with its size, and are much constricted on the upper suture. The transverse ribs, which differ from 8—12 in number, are oblique and obsolete next the upper suture, similarly as in *A. papilionacea*, but they are always much sharper. No spiral striation is perceptible in any of our specimens, which are well preserved on the exterior surface. The anterior canal has not been seen perfect, but it could not have been of greater length than is indicated in the outline, and, including the last whorl, it had about the same height as the spire, consisting of all the preceding whorls. The wing is prolonged posteriorly into a rather long point and anteriorly simply curved towards the canal. Only a very slight sinus seems to have been present between the canal and the wing.

The small number and the form of the transverse ribs of the whorls combined with the shape of the wing distinguish the Indian species without difficulty from *Al. costata*, Sow. of the Gosau deposits (Zeckeli, t. XII. Figs. 1 and 2, *Stoliczka*, Sitzungsab. Ak. Wien. LII, p. 66) or from *Ap. Robinaldina*, D'Orb. (Pict. Mat. Pal. Suisse, Ste. Croix, Pl. 92, Figs. 9 and 10.)

Localities. N. of Alundanapooram, E of Anapaudy.

Formation. Trichinopoly group.

4. *ALARIA ACICULARIS*, *Stoliczka*. Pl. II, Figs. 16 and 17.

Al. testa conica, aciculari; anfractibus numerosis, subplanis, transversaliter costulatis, spiraliter minutissime striatis, callositate plus minusve oblectis atque politis; ultimo anfractu subinflato, spira breviori; rostro brevi (?), labro expanso, postice ad anfractum penultimum affixo.

Spiral angle 35° — 40° , sutural angle 5° .

This little form seems to be occasionally nearly as much covered with an enamel coating as the *Rost. palliata*, with the exception, that the covering is more equally distributed over the entire surface of the shell. The whorls are nearly flat, separated by slight impressions, which mark the sutures. The apex on well preserved specimens is perfectly covered, and the ventral or front side of the shell equally so. Where the coating is thinner transverse ribs in rather an oblique position, and a very fine spiral striation, are perceptible. The last whorl is somewhat convex, shorter than the spira, subangulated below, and apparently anteriorly produced into a short pointed canal only. The outer lip is expanded, reaching posteriorly not above the previous volution; its margin has not been seen preserved. This species resembles greatly *Ap. acuta*, D'Orb. (Mat. p. I. Pal. Suisse, Ste. Croix, II. p. 597, Pl. 93, Fig. 1), which differs by somewhat higher whorls and proportionally a greater

length of the last. Similar characters, combined with a greater spiral and smaller sutural angle separate the species now under description from *A. tegulata*, n. sp.

Locality. Olapaudy, in an oolitic, ferruginous rock; rather rare.

Formation. Arrialoor group.

5. *ALARIA TEGULATA*, *Stoliczka*. Pl. II, Figs. 11—13.

A. testa spira elongata, acuta, superficie polita; anfractibus 8—10, subconvexis, transversaliter costulatis; costulis parum obliquis, nonnullis fortioribus interdumque in anfractibus succedentibus continuis; ultimo anfractu circiter dimidium totius altitudinis occupante, ad basim spiraliter striato; rostro elongato (?), tenui; labio calloso; labro expanso posterius uncinato (?), postice nonnunquam supra anfractum antepenultimum decurrente.

Spiral angle 28° — 32° , sutural angle 8° — 12° .

The shell is rather elongated consisting of 8 or 10 whorls, which are slightly convex, transversally costulated and covered with a thin enamel callosity. These costæ are usually very thin, sharpened and numerous, only some of them, in about one-third of one volution separated from each other, being somewhat stronger. On the last whorl, which is of about the same height as, or a little higher than, the spire, the ribs become more distant and often disappear altogether. When the shell is not enveloped in the callose secretion it appears to have been all over covered with very fine spiral striæ; on the anterior portion of the last whorl this striation is usually retained. The transversal ribs owe their sharpness chiefly to the covering callosity, which unites them often through nearly the total height of the spire, continuing from one whorl to the other; this makes the sutures nearly obliterate, but they are always traceable by a slight impression.

The rostrum is not entirely preserved in any of our specimens and we have indicated its probable length by an outline. The inner lip is rather callose and the secretion of the enamel-coating seems to proceed from this portion of the mantle. The outer lip is expanded, reaching posteriorly on the penultimate whorl and occasionally little higher; it seems to have been prolonged into a hook-like wing, while anteriorly it is much contracted. This species differs from *A. acicularis* by a greater height of the whorls of which the ribs are not so much oblique, by a smaller spiral and larger sutural angle, and apparently also by a greater length of the anterior canal or rostrum. The numerous ribs, resembling sharp lamellæ, are characteristic of this species, and do not admit an identification with any known species, although when these lamellar ribs are not preserved, the resemblance becomes apparent to several others.

Localities. Andoor, Kolakonuttom, N. of Serdamungalum: Comarapolliam, Arrialoor, S. E. and N. E. of Karapaudy, Olapaudy and near Veraghoor. Except at Olapaudy not common.

Formation. Trichinopoly-(to which the three first named localities refer) and Arrialoor-groups.

IV. ROSTELLARIA, *Lamarck*, 1799.1. ROSTELLARIA PALLIATA, *Forbes*. Pl. II, Figs. 18—20.1846. *Rostellaria palliata*, Forbes, Trans. Geol. Soc. Lond. VII, p. 129, Pl. 13, Fig. 15.1847. *Fusus Fontanieri*, D'Orbigny, Voy. Astrolabe et Zélée, Paléont. Pl. 5, Figs. 6 and 7.1850. *Rostellaria palliata*, Forb. D'Orb. in Prod. II. p. 228.1861. *Calyptraphorus palliatus*, Gabb. Proc. Am. Phil. Soc. VIII. p. 98.1864. *Aporrhais palliata*, Pictet and Camp. Mat. Pal. Suisse. 3me Ser. Foss. Ste.Croix, 2 pt. p. 629.

Rost. testa cuspidiformi, depressa, laevigata atque polita; juniore spira fusiformi, anfractibus planis, contiguis; adulta anfractu ultimo subventricosso, ad basim spiraliter striato; apertura elongate ovata, obliqua, antice (?) atque postice canaliculata; labro parum extenso, extus reflexo, postice callose pronato, spiram fere ad apicem dorso-lateraliter incrustante; labro callosissimo, postice ad marginem intus subdentato, infra atque lateraliter totam spiram cum apice tegente atque canali angustissimo a callositate labri separato.

The young shell of this species, or rather the first whorls of an imperfect shell, consists of about 5 or 6 flat volutions with scarcely impressed suture; the surface is smooth, exhibiting only fine striæ of growth and on the basis of the ultimate whorl a fine spiral striation; the angle of the spira varies from 30 to 35 degrees; on the whole the species in this state resembles very much an *Eulima*, or, when the anterior extremity of the columella is somewhat better preserved, a *Fusus*, for which it was mistaken by D'Orbigny (vide Fig. 19).

Well preserved specimens and usually those of larger size and in advanced age, have the last volution by much the largest and somewhat inflated, but at the same time a little depressed and occupying about one-half or little more of the total height of the shell. This last whorl is equally smooth and polished, or finely striated, like the others.

The aperture is elongated-ovate obliquely placed to the spire with a thickened inner and somewhat expanded outer lip. None of the specimens at our disposal have the anterior portion of the aperture perfectly preserved, but there are no certain indications of a long canal, as has been previously noticed. Most probably the aperture had only an anterior notch the outer margin being somewhat produced, as in the figure of *Rost. laevigata*, Melleville, previously referred to (p. 24).

The posterior canal is very distinct and separates both margins. The outer lip extends posteriorly as a callose band and covers the dorso-lateral portion of the preceding whorl up to near the spire; on the peristome it appears to be single, although not yet observed in complete preservation. The inner lip bears, near the posterior canal, a thick tubercle-like tooth and envelopes in a similar way as the outer lip with its callosity the whole frontal (Fig. 20a) or ventral portion of the previous whorls up to the apex, extending over this also on the sides of the shell. There it is considerably thickened and on the dorsal side in its entire extension, beginning at the posterior termination of the aperture, separated by a very narrow canal from the callosity of the outer lip. The lateral thickening of the outer lip

gives the shell a form very much resembling the point of an arrow. * Prof. Forbes (loc. cit.) attributed the formation of the callosity solely to the outer lip, which is not strictly the case. In Forbes' figure also the anterior extremity of the last whorl is probably more restored than the actual specimen seems to allow. Only further and better collections of specimens can clear up the doubt existing on these questions.

* *Localities.* S. of Serdamungalum in the Trichinopoly group, out of a bluish calcareous sandstone very similar to that near Pondicherry, wherefrom Prof. Forbes' specimens were procured. S. W. of Mulloor, Arriallor, N. of Olapaudy, W. and S. E. of Karapaudy, in the Arriallor group, out of a light-coloured, often somewhat siliceous or ferruginous sandstone.

Formation. Trichinopoly and Arriallor groups; more common in the latter.

V. PTERODONTA, D'Orbigny, 1843.

TYLOSTOMA, Sharpe, 1849. Quart. Journ. Geol. Soc. Lond. Vol. V, p. 376.

VARIGERA,* D'Orbigny, 1850. Prodrôme, Vol. II, p. 103.

Pter. testa ovato-elongata, crassa, superficie lævigata interdumque polita; spira conica seu turritellari; ultimo anfractu subventricosso seu inflato; apertura ovali, intus lævi atque callosa, antice emarginata seu canaliculata; labro parum dilatato, integro, intus ad marginem aperturæ denti-seu varici-forme incrassato, dentibus ac varicibus in anfractibus junioribus ad intervalla sæpissime preservatis.

So many different opinions had been already pronounced upon the nature of the fossils, which we unite under the above name, that we cannot pass over this subject without entering briefly on the history of these shells. At the same time it will be necessary to state the reasons which have induced us to regard two genera, universally believed to be totally distinct, as synonymous. Our remarks will, we trust, also show the necessity of classing the genus *Pterodonta*, as here characterized, in the immediate vicinity of the typical *Rostellariæ*.

* Although there cannot in reality be very much doubt, that D'Orbigny under his *Varigera* meant generically the same shells for which Sharpe proposed the name *Tylostoma*, still it is surprising, that no French palæontologist who has access to any of D'Orbigny's original specimens has thought it worth while to inspect the same and settle every doubt on this point by the publication of a few lines. If anybody reads D'Orbigny's characteristics of *Varigera* (Prodrôme, II. p. 103), he cannot help thinking, that D'Orbigny meant under his "varices longitudinales" external varices on the shell, for he does not even hint, that the specimens which he examined, were casts. Moreover, on page 68 *ibid.*, he says of *Var. Ricordeana*, "espece oblongue a fortes varices sur une surface lisse." Farther, he compares the varices of *Varigera* with those of *Scarabæus*. The fact is, that *Scarabæus* has very often remains of the margin of the outer lip placed externally on opposite sides, but these remainders are very thin and wear very soon away. I am, however, not aware of any such external traces of the margin of the aperture in any of the species, which have been described as *Pterodonta* or *Tylostoma*. If D'Orbigny had only cast-specimens before him, and if he meant by his varices *impressions of the same*; or if it can be supposed, that he understood these varices to be *internal*, his characteristics immediately become more intelligible; but who can reasonably presume on such essential alterations in the characteristics of a shell? The comparison of the last internal varix of *Pterodonta* with the internal varix near the margin of the outer lip, before it expands, in *Scarabæus* is perfectly correct; there could not be possibly a better comparison selected. It must, however, be remembered, that this varix is absorbed on the preceding whorls and only exists near each renewed apertural margin. There is, therefore, only one varix in *Scarabæus*, not several as in *Pterodonta*!

The *Pterodonta* are elongated, naticoid shells with a smooth and often polished surface, in appearance identical with that of the living *Rostellaria*. Besides striae of growth, the surface usually exhibits a very fine spiral punctuation, which appears to have been caused by the epidermis of the shell in its living state (vide Quart. Journ. Geol. Soc. Lond. 1849. V. Pl. IX. Figs. 4 a and 4 b). This punctuation recalls very much the shell surface of many *NATICIDÆ*. The last whorl is very often inflated or ventricose, exceeding in height that of the spire, or being equal to it; it is seldom met with shorter than the spire. The aperture is anteriorly notched or produced into a short canal. In one species, the *Pl. elongata*, D'Orb. (Pal. Franç. Crét. Pl. 218, Fig. 2) the canal is turned backwards; in most of the other species the anterior portion is only a little produced and emarginated, or, perhaps in young specimens, only effuse. In a large number of species not even this notch or emargination has been noticed, the specimens being known only from imperfect casts. Sharpe (loc. cit. p. 377), when speaking of *Tylostoma*, which name he proposed for a number of casts belonging to *Pterodonta*, says distinctly, that "they have no canal nor notch to the aperture," although his Fig. 3, on Pl. IX of *Tyl.punctatum* and Figs. 7 and 8 of *Tyl. ovatum* shew clearly, that the aperture *was anteriorly* a little produced, evidently with the effect of forming a short canal, or at least a notch. Further the author very properly notes the "strong analogies" of the specimens determined to be *Tylostoma* with D'Orbigny's *Pterodonta*, but he does not think it worth while going into greater details of these analogies, apparently on the ground of the latter genus belonging "to a very different family of Gasteropods." D'Orbigny, when noting the characters of his proposed genus *Varigera* (Prod. II. p. 103) records simply its relation to *Actæon*, which makes a special reference to a notch or canal unnecessary. By much more important are Pictet's notes on *Tylostoma* (vide Mat. p. l. Pal. Suisse. 3me. Ser. p. 349). He says first, that the aperture terminates anteriorly with an acute angle, which is very evidently shewn in all the specimens figured on plate LXXIII., *ibid.* After discussing several points of similarity between *Tylostoma* and allied genera, Professor Pictet concludes thus (loc. cit. p. 350);—"la seule modification que l'on puisse citer est, chez quelques espèces, *une faible dépression de l'extrémité antérieure* de la bouche simulant un *sinus très-peu profond*."* Nothing can be of higher value than these remarks of Pictet and the observations on Sharpe's figures. I may add, that I have examined our Indian materials very carefully, and I find, that in every case, when portions of the mouth are preserved, an anterior notch is distinctly traceable. We certainly cannot be, therefore, very far from the truth, when we conclude, that the specimens usually described as *Tylostoma* all possess if not a distinct canal, at least an anterior notch on the aperture. They can, therefore, without any objection, be classed with the other Siphonostomata.

We come now to the second important point, the expansion and the inner thickening of the outer lip. In three of the species, figured by D'Orbigny, namely, *Pterodonta elongata*, *ovata* and *inflata*, this expansion is perfectly distinct, entire, but never very considerable; the fourth species, *Pt. intermedia* is an incomplete cast. Expansions similar to those in the first three species are noticed in all the four species

* Italics are ours.

of *Tylostoma*, described and figured by Sharpe, and also in several of the species figured by Pictet (loc. cit. pl. LXXIII.). Two of our species show the expansion equally distinctly. It appears, that this expansion of the outer lip is never wanting in perfect specimens, but on the other hand it is almost certain, that it attains its proper size only after a certain stage of growth of the specimen. Before the expansion takes place the outer lip is provided internally with a strong elongated varix or fold, which narrows the space of the aperture laterally to a great extent. This fold or tooth is either smooth and simple, or it has the internal edge more or less crenulated, as is clearly exhibited in the figures of *Pterod. inflata* and *intermedia*, D'Orbigny, *Tylostoma ovatum*, Sharpe, and others. This inner fold or varix of the outer lip varies extensively in its size. In some specimens it is tooth-like and placed posteriorly, or in the middle, or nearer to the anterior termination of the outer lip; in other specimens it is much more prolonged and extends from the anterior extremity nearly to the posterior suture, that is, across the entire breadth of each whorl. There is every variation to be observed in the different species as regards the size and the strength of this thickening on the outer lip. In young specimens it is less or not at all developed, just as is the expansion of the lip itself. In this state of age the shell of *Pterodonta* cannot be better compared with any other genus than with *Priamus* (*Italia*, Risso). It would be interesting to compare with these forms better preserved specimens of D'Orbigny's *Globiconcha*. From the comparison of a large number of different forms, it appears, that the internal varices had occasionally been again absorbed during the succeeding growth, and that only some of the last ones, or actually only the last near the margin of the aperture, remain unaltered; cast-specimens of shells are especially important for studies of this kind.

It will be readily seen from these notes, that the number or even the existence of the varices or their impressions on the upper whorls cannot be regarded as being of very much value generically or perhaps even specifically. When the varix is tooth-like and anteriorly placed there will never be a trace of an impression seen on the upper whorl, because their lower portions are always covered by the succeeding volutions. This is, for instance, the case in the typical *Pterodonta inflata*, D'Orb. The impressions of the varices *do*, however, exist, in this species as I had occasion to observe on a few well preserved casts, which I broke up for that purpose. In cases where the varices are placed posteriorly, or where they extend close to the posterior margins, their impressions will be clearly observable on all the upper whorls, unless the varices had been previously absorbed. Instances of all these variations may be seen by a comparison of the figures of D'Orbigny's *Pterodonta* and Sharpe's and Pictet's *Tylostoma*, the identity of which can scarcely be doubted from all that is known of their structure at the present.

Having thus treated at length the generic characters and their variations in *Pterodonta*, it remains only to say a few words as regards the classification of the genus among the numerous families of the order PROSOBRANCHIA.

Excluding a few fusiform species, to which we shall draw special attention subsequently, we have in *Pterodonta*, *smooth shells of an oval or conical shape, with*

the aperture anteriorly notched or canaliculated and with an expanded outer lip. It is evident, that these are the principal characters of *Rostellaria* (sensu restricto) and that we do not in the least need to alter D'Orbigny's original proposition as to the classification of his *Pterodonta* in the family *ALATA*.

It is difficult to understand what subsequently induced this acute observer to place *Pterodonta* in the neighbourhood of *Actæon* and others. It could only be on account of its evident relationship to *Varigera* (? *Tylostoma*), which from the incompleteness of the specimens D'Orbigny was induced to consider to be allied to *Actæon*. Strictly speaking there is, however, scarcely any similarity to be found between *Actæon* and *Pterodonta*, for the punctuation of the surface in the shell of the latter is identical with that of the true *Rostellariæ*, *Conus* and others, but rather different from that of *Actæon*, *Ringicula* and other *OPISTHOBRANCHIA*.

According to these subsequent alterations of D'Orbigny, the genus *Pterodonta* (with *Tylostoma* and *Varigera*) has been classed in very different ways. Woodward quotes it next to *Actæon* (*Tornatella*) in the family *TORNATELLIDÆ*. Chenu places it with *Actæonella* in the *PYRAMIDELLIDÆ*. Pictet believes, that *Tylostoma* belongs to the family *Rissoïdæ* and *Pterodonta* to the *BUCCINIDÆ*!

I confess that I am unable to find any support for any of these propositions.

It is scarcely necessary to remark, that the degree of the expansion of the outer lip and of the prolongation of the anterior canal cannot reasonably be regarded as of very great importance in a classificatory point of view within the limits of the family *ALATA*. The genus *Aporrhais* exhibits all these variations in one species, or rather in one and the same specimen during different stages of age. Many *Strombi* afford similar instances, and the typical *Rostellariæ* as well. The canal is scarcely produced in many fossil species of *Rostellaria*, and Deshayes very properly directs attention to these forms as being closely related to *Terebellum* (vide Anim. sans vert. Paris, 1866, Tom III, p. 463). In other species, several of which had been separated under the name *Hippocrene*, the canal is curved towards the face of the aperture. The same is the case with several *STROMBIDÆ* and the genus *Pugnellus* (vide Pl. III). Many species of *Pterocera* have the canal recurved backwards. It is therefore nothing extraordinary or new, when we find several of these variations represented in *Pterodonta*; they may be and are more important as specific, than as generic, characters, unless combined with some other marked distinctions. The figure of the solitary species *Rostellaria Cailliaudi*, Desh. (loc. cit. Pl. XCI, Fig. 3) could, as regards the shortness of the canal, expansion of outer lips and the general form, represent a species of a *Pterodonta* nearly quite as well.

If we look for an analogue of the internal varix of the outer lip, we can find it in *Obeliscus* (*PYRAMIDELLIDÆ*), the larger number of species of which have remains of the internal ribbings of the outer lip preserved for some distance on the upper volutions. These remains are, however, usually very closely placed to each other, and represent the internal striation or plication being often interrupted by furrows rather more than by the formation of separate varices. Another very marked analogy is to be found in Deshayes' figure of *R. Dewalquei*, ibid. (Pl. LXXXVIII, Fig. 18). Deshayes (loc. cit. Tom. III, p. 451) attributes the existence

of this varix or tubercle to an accidental secretion; upon this we, of course, cannot pronounce any opinion, not being in possession of any specimens of this very rare shell. The similarity of the interior varix to that of *Pterodonta* must, however, strike every observer, and we wish, therefore, to draw special attention to this fact. Subsequent researches will, it is to be hoped, throw some more light upon this 'accidental secretion.' As the varix in *R. Dewalquei* is placed near the edge of a greatly expanded outer lip, it is a matter of course, that no trace of its existence could remain preserved on the previous whorls. The distinction of this species from a *Pterodonta* is, therefore, quite evident; still the presence of the tooth offers some analogy.

From all these remarks it is, we trust, tolerably certain, that *Tylostoma* and *Pterodonta* are identical forms, which must be classed in the family *ALATA*. Still on the other hand it cannot be denied, that the discovery of new and better materials may call for several changes, and perhaps even sub-divisions, in the genus at present known as *Pterodonta*. I would consider the following point only as one of these probable changes.

Pictet described in his "Fossiles des Grès verts," p. 265, Pl. 26, Figs. 1 and 2, two species *Pterodonta gaultina* and *Pt. carinella*, both of which differ from D'Orbigny's typical *Pterodonta* and the species of *Tylostoma* by their elongated fusiform shell, provided apparently with a long straight canal, but still with internal varices or tubercles on the outer lip, leaving at certain intervals impressions on the casts of the shells. On account of the produced canal M. D'Orbigny referred these two species to *Pterocera* (Prod. II., p. 132), having then changed his original idea about *Pterodonta* and believing in its relation to *Actæon*. M. Pictet at first agreed with these changes (vide Grès verts, p. 549), but lately (Mat. Pal. Suisse, 3me. ser. p. 626) he refers the *Pt. gaultina* to *Aporrhais*, and (ibid. p. 657) the *Pter. carinella* to *Murex*. There have not been any better preserved specimens of these species found, and M. Pictet says, that he considers these changes only as provisional. It would not be in the least surprising, if further materials would show the close relationship of these species to *Pterodonta* and confirm in this way Pictet's original determinations. I think it very likely that this may be the case.

Seeley described (Ann. Mag. Nat. Hist. ser. III, Vol. VII, p. 282—283) from the upper Greensand of Cambridge two species *Pterodonta marginata* and *Pt. longispira*. Both are known from casts only, on which, however, the beginning of an expanded outer lip, similar to *Alaria* or *Aporrhais*, is distinctly traceable. The upper whorls are ribbed transversally, and there appears to be a strong impression of an internal tooth or tubercle near the aperture. These tubercles are placed below the median keel, where in other species there is always some kind of an insinuation and contraction of the aperture, generally caused by a thickening of the outer lip. No trace of these tubercles has been as yet observed on the whorls of the spire. Should, however, these two species be proved to belong to *Pterodonta*, they must be classed with the two last named species of Pictet in the same section. A fifth species, which belongs to this same division of fusiform *Pterodontæ*, is figured on our Pl. V,

figs. 6—8. All the specimens are imperfect with regard to the aperture, but the outer lip could not have been very much expanded. The shell, as it appears from single fragments, has been smooth similar to other *Pterodonta* and *Rostellaria*.

The number of species of *Pterodonta*, which, as at present defined, has been found chiefly in cretaceous deposits,* is tolerably large. This might be to some extent expected from the well-known great representation of the family *ALAZA* in cretaceous rocks. In addition to the five species already mentioned, the following are quoted by Pictet under the genera *Pterodonta* and *Tylostoma* (vide Mat. Pal. Suisse. 3me Ser. p. 676 and pp. 358—359). *Pterodonta elongata, inflata, naticoides, ovata, intermedia, pupoides* and *scalaris*, of D'Orbigny; *Pterodonta obesa*, Coquand; *Pterodonta* (*Tylostoma* or? *Varigera*) *Ricordeana, Rochatiana, Fittoni* (rather *Fittoniana*, from the Isle of Wight), *Escragnollensis, Guerangeri* (*Guerangeriana*), *Carentonensis* and *Toucasiana* of D'Orbigny; *Pterodonta Torrubia, punctata, ovata* (this must receive another name) and *globosa* of Sharpe; *Pt. Laharpi* (*Laharpiana*,) *fallax, Villersensis, naticoides* (must receive a new name), *elliptica, depressa* and *gaullina*,† of Pictet and Campiche. *Pter. subinflata*, Coquand, (Geol. and Pal. de Const. 1862, p. 179) has been proposed for the Algerian species, which was first noted by Bayle as *Pt. inflata*, D'Orb. The *Natica patens*, Binkhorst (Mon. Gast. et Ceph. craie sup. de Limbourg. 1861, p. 18, Pl. II, Fig. 1) may very probably be shown to be a *Pterodonta*; certainly it is a strange *Natica* with "labro dilatato, reflexo." Morris in his Catalogue (p. 274) quotes a species of *Pterodonta*, allied to *Pt. elongata*, D'Orb., from the upp. Greensand of Warminster, and a species of *Tylostoma* (ibid. p. 285) from the lower chalk of Chardstock. Morris follows D'Orbigny's original proposition, as regards the former genus, but he places the latter in the *NATICIDÆ*. I have to add here the *Pterodonta crassa*, Schafhäutl, (Süd-bayerns Leth. geognost. Leipzig 1863, p. 193, Pl. LI, Fig. 1, named here by mistake *Pleurodonta crassa*). It is a species somewhat like D'Orbigny's *Pt. ovata* in form, but neither in the description nor in the figures are any of the impressions noticed. Still it seems to be a true *Pterodonta*, and the omission of these impressions is probably due to the bad preservation of the specimen. It is impossible to say from Schafhäutl's singular references, whether the species is cretaceous or not, for he confounded every thing.

* The two Jurassic species, which probably belong to *Pterodonta*, are *Melania gigas*, Thurmann, (Leth. Bruntrutana, p. 84, Pl. VI. Fig. 18) and *Pterodonta corallina*, ibid. p. 84. I do not know where the second species is described.

† It would be premature to change this and other specific names, because the other *Pt. gaullina* (*Aporrhais*, Pictet,) could be placed in another genus or subgenus, or whatever it may be called.

‡ I may be excused, when in the following pages I have occasionally omitted a reference to this publication of Mr. Schafhäutl. I am compelled to do so, because it is impossible for me to make out, which fossils are cretaceous and which are not, and to refer to the former only can be my present object. There is in reality no very great loss, for most of the specimens are badly preserved casts, although occasionally described with the opercula! I should not like to pronounce an opinion on the merit of the geognostical studies, but it is to be regretted, that the valuable results, which could have been obtained from a careful examination of that interesting collection of fossils, have been made so thoroughly unavailable by the singular ideas regarding geognostical formations.

With very few exceptions nearly all the species of *Pterodonta* were found in the deposits of Southern Europe, and of the two found in Algeria, one is identical with a French species. I am not acquainted with a single species from the Alpine Gosau-deposits, and cannot offer the slightest opinion as to the *Pt. toucasiana*, which D'Orbigny quotes as occurring also in the Gosau (Prodrome II. *Varigera* id. p. 221). Perfectly inexplicable remains to me also the ground, upon which D'Orbigny transferred (ibid. p. 221), the *Tornatella abbreviata*, Philippi, to his *Varigera*, in spite of the Gosau shell being distinctly canaliculated in front, and having at least one distinct fold on the columella. *Pictet* (Mat. Pal. Suisse. 3me ser. p. 359) believed it an *Actæonella*, according to *Zekeli*, but I have already shown in my 'Revision of the Gosau Gastropoda' (Sitzungsber. k. Akad. Wien, LII, p. 42), that the species is an *Iliceria*, a genus of the *PYRAMIDELLIDÆ*. In the cretaceous deposits of Northern Europe only very few sporadic species have been noticed. Drescher described lately one (Zeitsch. deutsch. geol. Gesellsch, vol. xv. p. 339, Pl. IX. Fig. 12), which he identifies with *Pt. inflata*, D'Orbigny, although I do not think this identification very successful. The convexity of the whorls is rather different in the two species. The impressions of the internal folds on the upper whorls in Drescher's specimens reach posteriorly nearly to the suture, while they scarcely ever appear traceable on the upper whorls of the original *Pter. inflata*; the inner fold or varix being in this species much shorter. As regards this point, Drescher's specimen shows more close relation to our *Pterodonta Ootatoorensis*. At the same time there is no necessity to be in great haste to find a new name for the German specimen, as it is merely an *incomplete* cast.

I would take this opportunity of calling attention to two species, which occur in the hippuritic limestone near Kutschlin in Bohemia, namely, *Pterocera gigantea*, Goinitz, and *Pt. gracilis*, Reuss (Verst. Boehm. Kreidef. 1845, p. 48, Pl. XI., Figs. 14, 15 and 21). Both have the general form of true *Pterodontæ*, and the shell appears to have been smooth and thick. The latter species has been already supposed by D'Orbigny to be a *Pterodonta* (Prod. II., p. 191), but nothing positive can be ascertained, until the specimens have been carefully re-examined. We may have then within the Mediterranean circle of the cretaceous deposits nearly thirty species of *Pterodontæ*, but I need scarcely repeat, that most of them are known from deficient casts only, and it is very possible, that the discovery of better materials may reduce this number to one-half or two-thirds. I am not aware of any species having been described from the American cretaceous deposits; or from Australia.

The South Indian cretaceous rocks have yielded four species, three of the typical *Pterodonta*, and one belonging to that group of fusiform shells. Two of the fossil species are characteristic for the lowest beds, the Ootatoor group, namely, *Pt. Ootatoorensis* and *Pt. terebralis*; the *Pt. nobilis* occurs in the Trichinopoly, and the *bulimoides* in the Arrialoore beds.

1. PTERODONTA (?) TEREBRALIS, *Stoliczka*. Pl. V, Figs. 6—8.

Pt. (?) testa elongata, fusiformi, anfractibus subplanis atque lævigatis; apertura oblique trapezoidali, antice in canalem rectum et moderate longum extensa; labro interne pliciforme incrassato, plica multidentata, ad intervalla impressiones nonnullas in anfractibus superioribus formante; columella solida, biplicata.

Spiral angle 22° — 25° ; sutural angle 12° — 16° .

Probable height of last whorl : total of shell (consid. as 1'00) 0'21 to 0'23.

An elongated fusiform shell, composed of numerous flattened volutions, the surface of which is perfectly smooth, as seen from fragments of the preserved shell. The last whorl is very much shorter than the spire, exceeding only by a little the fifth part of the total height. The aperture must have had an oblique trapezoidal shape, provided anteriorly with a moderately produced canal. The columella is solid with two very oblique folds, which become almost obsolete at the mouth. Judging from a cast specimen (Fig. 8, on Pl. V.) which appears to be nearly complete, the outer lip seems to have been only slightly expanded. The internal varix was long and provided with about six teeth, the middle ones being the strongest. There are usually three impressions of the former varices traceable on the last whorl, each at one-third distance in the circuit; on the penultimate whorl, there are generally but two of the impressions, and higher up they disappear altogether. This seems to be a similar case to that noted by Pictet in his two species, apparently belonging to the same sub-division of *Pterodonta*.

Localities. West of Odium in a brownish calcareous sandstone, and east of Parchairy in a yellowish arenaceous limestone; rare.

Formation. Ootatoor group.

2. PTERODONTA BULIMOIDES, *Stoliczka*. Pl. V, Fig. 5.

Pt. testa exigua, bulimiformi, elongata, apice obtusa; anfractibus septenis, convexis, accumulatis lævigatisque; apertura angulate-ovata, antice paulo emarginata; labro in specimine unico haud expanso, interne ad intervalla costato; columella solida.

Spiral angle about 40° ; sutural angle 5° .

Height of last whorl : total of shell (consd. as 1'00) 0'37.

In external shape this small shell recalls very much the form of a *Bulimus* or *Achatina*. Although only eleven mm. high it numbers seven volutions, of which the last one is little more than one-third of the total height. The apex is obtuse, the whorls convex, with strongly impressed sutures, the surface covered with fine striæ of growth. The columella is solid; the aperture oval, pointed on both ends and anteriorly slightly notched. It is evidently a young shell, and we do not wonder, therefore, that the outer lip is not perceptibly expanded. The inner fold-like varices are, however, certainly present, as may be seen by an inspection of Fig. 5 b. on Pl. V. The relative position of these varices could not be ascertained, for it could not be done without the destruction of the unique specimen, the rock, in which it is bedded, being a loose gritty sandstone. From the bulimoid form and the large

number of whorls the species may for the present be easily recognised and compared with other allied species.

Locality. Near Veragloor in the Trichinopoly district.

Formation. Arrialoor group.

• • • 3. PTERODONTA NOBILIS, *Stoliczka*. Pl. V, Figs. 2 and 4.

Pt. testa ovate-elongata, anfractibus circiter septenis, subconvexis composita, ultimo in altitudine spiræ fere æquali, superficie minutissime punctata atque posterius prope suturas nonnullis striis spiralibus ornata; labro ad marginem paululum sinuoso atque expanso, intus variciformi incrassato: varicibus longis, fere ad suturam posteriorem extensis atque $\frac{2}{3}$ in uno circuitu distantibus; labio calloso, lævi; columella in junioribus speciminibus excavata, in adultis vix fissurata; apertura oblique ovata? antice emarginata, postice acuta.

Spiral angle 50° — 55° ; sutural angle 10° — 12° .

Height of last whorl: total of shell (consd. as 1.00) 0.50—0.55.

This species is principally characterised by its elongated form, the last whorl being of equal height or a very little higher than the conical spira. The whorls are moderately convex, the surface of the shell is usually smooth, minutely punctated and posteriorly near the suture provided with a few fine spiral striæ. The last volution is inflated and evenly rounded. The outer lip is slightly expanded, internally with a strong and long varix. On the upper whorls impressions of varices are visible at two-thirds distance on each whorl. The columella is in young specimens hollowed out, but in fuller grown specimens the thickened inner lip covers the opening perfectly (vide Pl. V., Fig. 2). In none of our specimens is the anterior portion of the aperture preserved, and its shape has been, therefore, only indicated by an outline in our figure.

Locality. Rare in the sandstones near Garudamungalum in the Trichinopoly district.

Formation. Trichinopoly group.

• 4. PTERODONTA OOTATOORENSIS, *Stoliczka*. Pl. V, Figs. 1—3.

Pt. testa late conica, anfractibus senis seu septenis, suturis parum impressis atque fere ascendentibus sejunctis, subconvexis lævigatisque; spira brevi; ultimo anfractu maximo, inflato, ad medium obsolete carinato; superficie minutissime punctata; apertura ovate-elongata, antice emarginata; labro parum dilatato, varicibus internis longis, crassis, pliciformibus earumque impressionibus in anfractibus superioribus interdum fere oppositis.

Spiral angle 60° — 70° ; sutural angle 2° — 4° .

Height of last whorl: total of shell (consd. as 1.00) 0.55—0.60.

• A broadly conical shell, composed of six or seven slightly convex volutions, of which the last one is inflated and generally higher than the spire. The surface of the shell is smooth, marked only with fine striæ of growth, and minutely punctated:

An obtuse and slight keel is usually traceable about the middle of the last whorl; if however the casts are not well preserved, the convexity appears to be almost quite uniform. The aperture is oval, oblique and anteriorly distinctly notched. The outer lip slightly expanded, internally provided with a thick fold-like varix. The position of the varices on the upper whorls is very variable. Sometimes they are nearly opposite, and as the entire shell is usually somewhat depressed from front to back, its general shape recalls very much some of the smooth *Ranellæ*, or a *Scarabæus*, neglecting of course the external varices or laminae. In other specimens the impressions are somewhat more distant than half of a circuit, as may be seen by a comparison of Fig. 3 a, Pl. V. On the uppermost whorls, or respectively in young specimens, the varices do not seem to have become developed at all, and very often, when present, their number and the position are scarcely in two specimens exactly the same and corresponding. The inner lip is callose, leaving a sort of fissure in the columella. I had already occasion to mention (vide p. 41.), that this species agrees far more with one described by Drescher from Germany than with the true *Pt. inflata*, D'Orb., with which it has merely the general form in common.

The species is a very characteristic fossil of the Ootatoor group and comparatively not very rare. It occurs usually in casts which show several variations in the height of the spire and the proportions of the last whorl.

Localities. Neighbourhood of Ootatoor, Odium, Moraviatoor, Monglepaudy, Coonum and Puravoy, in limestones or calcareous sandstones.

Formation. Ootatoor group.

II. Family—CYPRÆIDÆ.

The genera *Cypræa* and *Ovula*, as fixed by Lamarck, are the typical forms of this family. *In general the shells are ventricose, globose, or elliptical: the last whorl embracing totally or to a great extent the former; polished, being covered by an enamel coating; anteriorly and posteriorly produced into a short canal, notched and effuse on both ends or at least at the anterior extremity. The aperture is narrow, linear, extending over the entire length on the ventral side of the shell, with an inflexed outer lip.*

There exists a good deal of difference in opinion as to the genera which ought to be admitted into this family. Usually only the two genera mentioned above, *Cypræa* and *Ovula*, have been quoted, according to Lamarck. *Erato* was for some time not accepted at all, but afterwards was by many conchologists united with this family, as well as the singular genus *Pedicularia*. *Marginella* is by some authors described next to *Cypræa*, while others refer it, apparently more correctly, to the neighbourhood of *Voluta*. Deshayes is strongly opposed to this classification and retains *Marginella* in the CYPRÆIDÆ (An. s. vert. bas. Paris, 2d. edit. III, 543). H. and A. Adams (Genera, I, p. 263, etc.) have established three families, CYPRÆIDÆ, AMPHIPERASIDÆ and PEDICULARIDÆ. There are no doubt several distinctions between *Cypræa* and *Ovula* (*Amphiperas*),—but apparently not equal to those in other

families, so as to render total separation necessary. The animals of both are in fact so very much alike, that several naturalists formerly suggested to unite them into one genus. The shell offers equally many points of relation, as may be seen from the above references. It appears, that this relation will be sufficiently preserved, if we retain the family *CYPRÆIDÆ* as formerly, and in this distinguish two or three sub-families, as suggested by Swainson in his 'Conchology,' namely:—

a. *PEDICULARINÆ*, with two genera; *Pedicularia*, Swains.—the shell being convolute with lateral spire, the outer lip partly and irregularly inflexed, aperture widened, as long as the entire axis of the shell, without teeth on the inner and very seldom on the outer peristome. There are two or three living species known, which feed mostly on Zoophytes, *Ped. sicula* and *elegantissima*, to which Dr. Gray adds the *Coralliobia fimbriata*, H. Adams (vide Guide, 1857, p. 74). Mr. Sequenza described lately a fossil (miocene) species *Ped. Deshayesiana* (Jour. de Conch, 1865, 3me ser. vol. V, p. 59, Pl. IV, Figs. 1—3). A second genus of this sub-family is *Dentiora*, Pease with the species *D. rubida*, P. from the Sandwich Islands. (Proceed. Zool. Soc., Lond., 1862, p. 240). The principal distinction from *Pedicularia* is the "columella plana vel excavata, intus compressa, *dentata*." I am not aware of any cretaceous species having been reported in this sub-family.

b. *OVULINÆ*, being throughout involute shells.

c. *CYPRÆINÆ*, being principally convolute and becoming mostly involute with advancing age.

b. Sub-family—*OVULINÆ* (*AMPHIPERASIDÆ*, H. and A. Adams).

The former genus *Ovula* or *Ovulum*, as adopted according to Lamarck and Sowerby, has been separated by H. and A. Adams into five genera, which appear to be natural and tolerably well defined, namely, *Simnia*, *Volva*, *Ovula* (*Amphiperas*), *Cyphoma* and *Calpurnus*, in which order the shells exhibit gradually their relation to the *CYPRÆINÆ*.

The *OVULINÆ* are in all their stages of growth perfectly involute shells, more or less pointed on each end and canaliculated or emarginated; covered with a moderately thick enamel coating, generally smooth and polished and rarely provided with a fine spiral striation. The surface is usually white or at least not richly coloured. The aperture extends through the entire length of the transversal diameter of the last whorl, is more or less narrow, and on the inner lip not toothed. The outer lip is reflexed in a smaller or greater degree, and in some genera partly, in others over the entire margin, provided with teeth or a similar kind of striation. On the whole, the *OVULINÆ* are not very common shells. H. and A. Adams quote 47 recent species, and Reeve describes in his Monograph of *Ovulum* (Conchologia Iconica, 1865) 39 species, excluding some species of *Volva*.

Neither are the tertiary forms, belonging to this sub-family, numerous, and those which are known,—some nine or ten species,—are by authors usually reported among the rarest shells. They need to be divided into the different genera, of which *Ovula*, *Simnia* and *Volva* appear to be represented. Still by much rarer are the cretaceous species, although D'Orbigny and several authors subsequently endeavoured to revert

the greater number of known *Cyprææ* into *Ovula*. Pictet (Materiaux p. l. Paléont. Suisse. 3me. ser. 1864, 2me. pt. p. 687) quotes in his review of the cretaceous *OVULINÆ* seven species, four European and three Indian, namely—

1. *Ovula Marticensis*, D'Orb. (*Cypræa Marticensis*, Math. 1843) is probably a true *Cypræa* (vide *Cypræa* hereafter).

2. *O. involuta* Pictet et Campiche (*Marginella involuta*, Zek. 1852), has already been asserted by me to be a true *Cypræa* (vide Revision der Gastrop. d. Gosaugeb. in Sitzungsab. Akad. Wien. 1865, vol. LII.).

3. *O. striata*, Zek. was in the same paper referred by me to *Pseudocassis* of Pictet and Camp.; it is as yet known from a single specimen only, and is either a *Pseudocassis* or a *Cypræa*, not an *Ovula* or any other genus of the *OVULINÆ*.

4. *O. cretacea*, D'Orb., is a species as yet of doubtful existence, being based neither upon a description nor a figure.

5. *O. antiquata*, D'Orb., from Pondicherry, figured in the Palæont. of the Astrolabe, is a true *Ovula* and will be described hereafter. *Cypræa Cunliffei*, Forb. must be excluded from the synonyms, as being a true *Cypræa*.

6. *O. Kayei*, D'Orb., is a *Cypræa*, and most probably the old *Globiconcha ovula*, D'Orb., which Coquand showed to be a *Cypræa*.

7. *O. incerta*, D'Orb., is an incomplete specimen of *Cypræa Neuboldi*, Forbes.

From these remarks it will be seen that the true number of known cretaceous species of the sub-family *OVULINÆ* is reduced to *one*, which is a true *Ovula*. The *O. cretacea*, D'Orb., must for the present be left doubtful, whether it belongs to this group at all or not, until it may be possible to ascertain the species intended by D'Orbigny's name.

VI. OVULA, Bruguiere, 1792.

Ov. testa involuta, ventricosa, ad extremitates subacuta, subcanaliculata seu lente emarginata; apertura angusta: labro inflexo, interne denticulato seu substriato, labio edentulo.

The uncertainty as to the application of the name *Amphiperas* of Gronovius must prevent its replacing Bruguiere's denomination, which is so thoroughly known to all conchologists. Nor does there seem to be any necessity to alter it into *Ovulum*, Sow. accepted by L. Reeve in his last Monograph of this genus (Conch. Icon. pts. 246 and 247, 1865).

The usually inflated form of the shell, being little produced on both extremities and not distinctly canaliculated, the narrowness of the aperture, stronger inflexion and internal striation or denticulation of the outer lip, and the smoothness of the exterior surface show sufficiently the relations of this genus to the *Cyprææ*, as well as on the other hand they render the separation of *Calpurnus*, *Cyphoma* and *Volva* necessary.

We have to notice only a single species, which has been already in 1847 figured by D'Orbigny from the neighbourhood of Pondicherry. Mr. H. F. Blanford men-

tions in his Report on the cretaceous deposits of Trichinopoly and South Arcot—Mem. Geol., Surv. India, Vol. IV, Pt. I. p. 140—‘two or three’ species of *Ovulum* and repeatedly in other places quotes the name of the same genus. He undoubtedly adopted here D’Orbigny’s views, thinking that the *Cyprææ* described by Prof. Forbes had been correctly re-determined by him as *Ovulæ*. In this, however, Mr. D’Orbigny was totally misled, as I shall have occasion to prove hereafter, affirming Prof. Forbes’ determinations.

1. OVULA ANTIQUATA, D’Orb. Pl. IV, Fig. 1.

1847. *Ovula antiquata*, D’Orbigny, Voy. Astrolabe et Zélée, Paléont., Pl. IV, Figs. 4—6.

1850. " " " in Prod. II., p. 225 non *Cyp. Cunliffei*, Forb.—*Ovula* idem, Gabb, Pictet, etc.

Ov. testa pyriformi, postice truncate rotundata, antice attenuata, depressa, involuta, lævi atque polita; apertura angusta, antice latiore atque vix emarginata; labro inflexo, arcuate expanso, margine in medio latissimo, ad extremitates gradatim angustiore, intus obsolete denticulato.

The pear-shaped form, being dorso-ventrally somewhat depressed, the curved and in the middle thickened outerlip, and a scarcely perceptible notch at the anterior termination, form the chief characters of this interesting species. The aperture is narrow and widens considerably in the anterior portion. The outerlip is inflexed and becomes much thinner towards each end; the dentition on this is so fine, that it is hardly perceptible. The posterior canal is scarcely marked, the outer lip being only on its posterior termination considerably thinner, although still thicker than in the corresponding place on the anterior extremity; both terminations are very slightly notched. A comparison of our figure with that of D’Orbigny (loc. cit.) will, we think, place the identity of the two beyond doubt. Forbes’ figure of *Cypræa Cunliffei* (loc. cit.) is certainly not very clear, but it could scarcely be confounded with the former, as it is evidently far less wide and more cylindrical in its total aspect.

Locality.—S. E. of Arriallor in the Trichinopoly district, where the single figured specimen was obtained. D’Orbigny procured his specimen at Pondicherry; it is, however, a question, from where it was brought to that place, although Arriallor beds occur not far off.

Formation.—Arriallor group.

c. Sub-family—CYPRÆINÆ (CYPRÆIDÆ, H. and A. Adams.)

The species belonging to this sub-family consist of *shells, which are either in all stages of growth convolute, or only and usually in the first period of their age, becoming afterwards involute, through a stronger development of the last whorls.* The involution is, however, often caused merely externally by a large secretion of enamel coating, apart from the extent of the last volution, and when it is removed, a more or less distinct spire becomes visible on the shell. In some *Cyprææ* (*sensu restricto*, Gray), which are often distinguished by a thinner shell, the spire remains visible even in full-grown specimens. The enamel covering, which exhibits usually the varied

colours of the different genera, is of the highest importance in the determination of fossil species, because when it is removed the shell receives a totally different aspect. The variety of the striation and tuberculation in *Cypræa*, *Ovula*, *Trivia* and others belongs to that enamel coating and usually disappears with this altogether, leaving no trace of its previous existence. The same applies to the dentition of the margins of the aperture.

We may meet with descriptions of *CYPRÆINÆ* in three different stages:

i. Being in a perfect state of preservation, in which case there cannot be any difficulty in determining the genus properly. Up to the present time, we may say, not a single cretaceous specimen has been found in this desirable state. The most complete is a specimen of *Cypræa Newboldi*, of which a representation is given (Fig. 2.) on our Pl. IV, but even this has the enamel surface a little injured, and the dentition of the lips has been partially lost in exposing the surface from the adhering rock.

ii. In recent species of *CYPRÆINÆ* the enamel coating is very closely combined with the shell, and a separation of both offers no small difficulty. It is known that the enamel has been separated by the mantle in successive layers, and that its thickness differs as well in different species, as on different places upon, and in different stages of age of, one and the same shell. When a *Cypræa* has been exposed for a long time to the changes of the climate, and when the shell has often been acted on by different mineral solutions, it is observed that the layers of the enamel begin to separate and fall off partially or totally. This may happen sometimes on the shores of the sea itself, before the specimens are finally buried in the rock; not uncommonly also the enamel may adhere to this more strongly than to the shell, and the latter be deprived of it in being cleared from the rock. In all cases such apparently perfect specimens with the shell—exhibiting usually striæ of growth—must be always very cautiously examined. They do not show generally the slightest trace of dentition on the margins of the aperture, and still appear to be in every way perfect. I am inclined to think that this state of preservation has especially led D'Orbigny and other authors into all those misapprehensions about *Ovula* and *Cypræa*. The enamel is often so uniform with the calcareous rock in colour and texture, that there is actually an impossibility of separating both. I have probably examined a larger number of cretaceous *CYPRÆINÆ* than any other palæontologist, and I know how many hours are often lost in their preparation without any success. A drop of acid does sometimes more than every other attempt; although obliterating the greater part of the surface, it still often leaves some traces of dentition perceptible, if any were present. In preparation with the needle alone, they are often lost without a perceptible trace.

iii. The shell may be perfectly destroyed, and this is, among the known cretaceous species, by far the most common state of occurrence. The species of *Cypræa* and *Arícia* show then generally an elevated spire, while those of *Luponia*, *Trivia* and others are usually quite involute. We need not be surprised, that several conchologists insisted upon not acknowledging any species, based on casts of the shells only. In some cases casts of shell may no doubt be very instructive, and if properly

handled, they may replace satisfactorily a perfect shell, as impressions of the shells do so generally. In other cases, however, they are of little use indeed, and if they do not admit even generic determination approximately, they ought justly to be rejected.

Among the casts of *CYPRÆINÆ* this is often actually the case, the thickened shell with its surface being totally removed, we get a smooth cast, which can give the shape of the true shell only approximately. There is one favorable condition to be mentioned, that is, if the aperture be filled up with stone, this preserves usually the impressions of the teeth on the margins of the peristome.

As the anterior portion of the shells is often much compressed, leaving internally a very small space, this prolongation is in the greater number of cases even not filled with the rock mass at all, or if it has been, it breaks with the greatest ease, without leaving any peculiar marks of its previous existence. This case may be seen on *Cyp. Newboldi*, or *Kayei*, on Pl. IV, and therefore it is, that such casts are usually much shorter than the original shell has been. All these difficulties are not seriously felt in determining neogene species, on account of the softer materials, in which they generally occur, but they have to be accounted for in the cocene, and great care must be taken in the determination of cretaceous species, for which reason alone we have specified them here.

The species which belong to this sub-family have been and are in general up to the present time described under the single generic name of *Cypræa*. Gray has after several repeated attempts at last succeeded in grouping the principal characters of the numerous species, and he divides the *CYPRÆINÆ* accordingly into several genera, some of which he takes as co-ordinate, others as sub-ordinate. The following genera, quoted by H. and A. Adams, are proposed; *Aricia*, *Luponia*, *Cypræa*, *Cypræocula*, *Trivia*, *Pustularia*, *Epona*. *Naria* appears doubtful, but there seems to be rather a necessity of one or two generic separations among the small and smooth species, which are partly referred to *Cypræa*, partly to *Luponia* and *Trivia*. Included in this sub-family ought to be, we believe, *Erato*, Risso, and *Pseudocassis*, Pict. et Camp., and excluded, *Marginella*.

The most apparent characters of the different genera are as follows:—

1. *Aricia* are pear-shaped shells, dorsally and posteriorly gibbose, and flattened below; in form they are most closely related to *Calpurnus* of the *ORULINÆ*; *Aricia moneta* is the best known shell of this type.

2. *Luponia* are globose, oviform and pear-shaped shells, below with convex margins of the aperture; the best known shell of this type is *L. tigris*.

3. *Cypræa* in the stricter sense includes the cylindrical forms with usually a thinner shell and conspicuous spire, of which *Cyp. argus* and *testudinaria* may serve as the best examples.

Connected with the difference in form of these three generic groups, there is always some kind of alteration in the dentition of the aperture, and it is carefully recorded by Gray. Several of the smaller specimens, partly distributed under *Luponia* and *Cypræa*, partly referred to *Trivia*, offer, as we have already noticed, some difficulty in being entered among these genera, and they will no doubt receive due attention.

4. *Cypræovula* is distinguished by its transversal striation, which replaces on the outer lip the dentition, and forms thus a passage to the next genus. The *Cyp. Capensis* is at present often met with in the collections, and there are several tertiary species known, which exhibit the characters of this genus very well.

5. *Trivia* is characterised by its spiral (usually called transversal) striation, being secreted from the mantle and replacing the dentition on the margins of the aperture, where these striæ become often somewhat changed in their form and tooth-like. Morphologically speaking, the striæ in *Trivia*, and the marginal teeth of the aperture in other genera of *CYPRÆINÆ* are identical. The two sub-genera *Pustularia* and *Epona*, as quoted by H. and A. Adams (loc. cit. p. 269) include rather characteristic forms, and will, we think, form good generic distinctions; namely,

6. Species, which are commonly somewhat depressed, and tuberculated or corrugated on the back, are assigned to *Pustularia*.

7. The shells of *Epona* are globose, mostly smooth, and with both anterior and posterior extremities much prolonged and contracted.

8. The genus *Erato* will be noticed in more detail hereafter.

9. *Pseudocassis* was established in 1863* by Messrs. Pictet and Campiche for a single cretaceous species, *Pseudocassis helveticus*. The specimens examined were only casts without any trace of shell or enamel-coating. The authors state, that there is no trace of teeth, or of any rugosity on either of the margins of the aperture. In my 'Revision of the Gastropoda of the Gosau-formation,'† I have, doubtfully, referred to this genus the *Ovula striata* of Zekeli, and at the same time, I have drawn attention to some indistinct crenulation on the outerlip of this species. So far as I can remember, there is nothing more to be noticed regarding the doubtful *Pseudocassis striata*, than I have already mentioned (loc. cit.) and for a decision on this point better materials must be obtained. It is, however, not impossible, that my suspicion (loc. cit. p. 63) of its being a *Cypræa* may be proved correct. The specimen figured by Zekeli has evidently the enamel surface wanting, and consequently the spire exposed: it is certainly not an *Ovula*, and, in any case, it belongs to the *CYPRÆINÆ*. Having recently had much occasion to observe closely the state in which fossil *Cyprææ* occur, I confess I am rather anxious to see, what results will be derived from an examination of the typical species of *Pseudocassis*, when it is met with complete with the shell preserved. A case in point happened to me lately. I had the description of the *Cypræa Kayei*, as a *Pseudocassis*, based upon the specimens figured on Pl. IV, Figs. 8—10, ready for more than a month: when, fortunately enough I found afterwards among our materials two other specimens, of one of which the representation is given, Fig. 7, and this, having had the shell partly preserved and being prepared with the greatest possible care, decided the point exactly in the contrary way. On a specimen of *Ps. helveticus*, very kindly presented to the Museum of the Geological Survey of India by Prof. Pictet, I cannot but persuade myself, that some impressions along the outer peristome have been originated by

* Paléontologie Suisse. 3me Ser. 2. pt. p. 361.

† Sitzungsab. Akad. Wien. Bd. LII., 1865.

some kind of denticles on the outer lip of the shell surface. So much as we know at the present of *Pseudocassis* from the details given by Pictet and Campiche, this genus differs from the other *Cyprææ* in not having any dentition or granulation on either lip of the aperture. The general form of the shell, the surface of which appears to have been smooth, agrees perfectly with the other *CYPRÆINÆ* and we can from this only conclude, that the genus (even if it remains defined as it is at present), must be placed in this sub-family. We have nothing from South India to add to it.

VII. CYPRÆA, Linné, (*sensu* Lamarcki).

As we have already briefly noticed the principal distinctions of the different sections or genera of the *CYPRÆINÆ* we would now only remark that, on account of the incompleteness of most of our specimens, we retain for the species under consideration the term *Cypræa* in its older sense, and give in addition (in parenthesis) the nearest newer determinations. Several of these names may require alteration, when more complete specimens are procured.

The *Cyprææ* live generally among rocks and on coral reefs, feeding chiefly on Anthozoa and other small animals. And there is every reason for believing, that they observed the same habits of living formerly. In the fossil state they are met with, either in sandstones or sandy beds, where they have been drifted, or in limestone banks with corals; very rarely are they found in clays, which generally have resulted from deposits in deeper waters. From European seas they appear to have mostly disappeared, although there is ample evidence, that they were formerly pretty numerous in the Vienna, Paris, and other, districts or basins.

Including the latest additions, there are about 170 living species of *Cypræa* now known; but this number must be a little reduced, because several among the smaller species (as *C. asellus*, *hirundo* &c., &c.) are more or less based solely upon variations in colour, which do not appear to be constant or specific. Hørnes is of opinion,* that the number of tertiary species does not exceed 44, of which 27 occur in the neogene and 17 in the eocene strata. Deshayes describes† 12 species from the Parisian basin alone. With a few recent additions from England, America and Australia, there will be at the least 55 tertiary species known, the majority of which are solely European. Up to the present time, we know very little of the *Cyprææ* from the tertiary deposits of the East. Several species occur in India (Sind, &c., and Burmah), but there has yet been no critical examination of these, or of their specific distinctions (if any) from species now living. And looking to the probable extension of tertiary seas from Persia, all through Central Asia into Japan, what a variety of forms may have existed over this wide range! Ascending from the eocene into the neogene period we may say, that the number of *CYPRÆINÆ* increases 50 per cent.

After many contradictions of D'Orbigny's assertions, that *Cypræa* did not occur in cretaceous rocks, it has at last been shown, that they are more numerous

* Foss. Moll. Wien, 1856; p. 61.

† Anim. sans vertebres &c., Tom. III, p. 557 &c.,

than had been suspected even a very short time since. At present (1866) four species are known from Europe, and two from America; to these we add from Southern India five new species, and one identical with an European species. This increases the total number of cretaceous *Cyprææ* to eleven. Including *Erato* (which is also found represented in Sth. India) and the *Pseudocassis helveticus*, the number of tolerably well-determined cretaceous *CYPRÆINÆ* will rise to thirteen. The East contributes about one-half to this number, from which it would appear, that even during the secondary epoch, the Eastern seas were probably warmer, and the *CYPRÆINÆ* consequently more numerous, than in the Western seas. The relative number seems to increase, as we proceed from America to the East, as it did also in the Tertiary times, and as it does very remarkably at the present time also.

The European species are the *Cypræa Kayei* (*Globiconcha ovula*, D'Orbigny); *Cypræa ovula*, Coquand (*non*-Lamarck) from France; *Cypræa rostrata*, Zekeli, and *Cyp. involuta*, Zekeli, sp. (*Marginella involuta*, Zek.; *Ovula involuta*, Pict. et Camp.)* from the Gosau deposits of the North-Eastern Alps;† and *Cypræa Deshayesi*, Binkhorst (*non idem* Gray) from the white chalk of Limbourg.‡ With regard to the earliest known cretaceous species, *Cypræa bullaria* and *C. spirata*, Schlotheim, we know nothing certain as yet. The species (probably identical) are not *Ovula*, but most probably true *Cyprææ*, and if, as Geinitz supposes, the former be identical with *Strombus ventricosus*, Reuss, it is possibly the same as the *Cyp. ovula* of D'Orbigny, or our *Cyp. Kayei*, Forbes. Gabb described two species from N. America, *Cyp. Mortoni* (Jour. Acad. Phil. 2 Ser. IV. p. 391, Pl. 68, Fig. 8), and *Cypræa Bayerquei* (Palæont. of California, 1864, I. p. 129), both of which are only imperfect casts and apparently very rare; but they belong to *Cypræa*.§

The South Indian species are *Cypræa ficulina* (an *Aricia*); *Cyp. Newboldi*, (a *Luponia*); *Cyp. Cunliffei* and *pilulosa* (belonging probably to *Luponia*); *Cyp. anomala* (probably *Epona*) and *Cyp. Kayei* (probably a true *Cypræa* in Gray's sense).

* Vide Revision der Gosau Gastropoden, Sitz. d. Akad. Wien, 1865, Bd. LII, p. 64.

† The *Ovula striata*, Zek. (*Pseudocassis*?) from the same deposits remaining doubtful.

‡ It is to be regretted, that in the splendid monograph of the Gastropoda and Cephalopoda of the Maestricht beds, the specific names, used for new species, were not examined with a little more critical care. They often refer to long and well-known species, as I have already had occasion to notice (*Ammonites Ootacodensis*=*colligatus*, &c., &c).

§ It would probably be worth while to draw attention here to the *Actæonella involuta*, Coquand (Palæont. Constantine 1862, Pl. VI. f. 2) from the cretaceous rocks of North Africa. It appears to be more probably a species of the *CYPRÆINÆ* than anything else, but as it is only known from a cast, no decided opinion can be formed. It could, perhaps, be a *Cyphoma* of the sub-family *OVULINÆ*. If there are any folds on the columella, it could possibly belong to the neighbourhood of *Volvulina* (*Actæonella laevis* and *crassa*), but it cannot remain under *Actæonella*, in the sense in which that genus has any claim to be retained.

1. CYPRÆA (ARICIA) FICULINA, *Stoliczka*. Pl. IV, Figs. 11 and 12.

Cyp. testa pyriformi: anticæ attenuata, supra globosa, spira brevi et acuminata, infra applanata, lævigata, striis incrementi nonnullis spiralibus, partim obsoletis, rugosa; labro expanso inflexo, infra applanato, ad marginem interiorem multidentato: dentibus pliciformibus; apertura posteriorem terminationem versus sensim angustiore; labio calloso dentatoque.

Shell globose above and flattened below, pear-shaped, being highest above the centre, exposing a short pointed spire and becoming gradually narrower towards the anterior extremity. The surface exhibits striæ of growth of unequal strength, and some spiral (as regards the axis of the shell transversal) and distant striæ are seen near the peripheral margin of the outer lip. The latter is below nearly quite flat, and has inside a large number of strong elongated teeth; the inner lip is callose and, so far as can be observed on a specimen from Kullygoody, provided with similarly elongated teeth. The aperture is widest anteriorly, becoming gradually narrower towards the upper or posterior portion of the shell. On the larger specimen, figured (Fig. 12) on Pl. II., the enamel coating is only very partially preserved and it is possible that the spire is much more covered than is seen in our figure, when this enamel is perfect. The partial spiral striation is visible only on places where the enamel has been removed, and does not in so far appear to be characteristic. The largest specimen in our collection from the sand beds west of Kullygoody measures 68mm. in columellar height, and 50 mm. in width.

This species appears to be a good example of Gray's genus *Aricia*, but several points have to be settled when a perfect specimen has been procured.

Localities.—Alundanapooram and W. of Kullygoody; only three specimens are as yet known.

Formation.—Trichinopoly group.

● 2. CYPRÆA (LUPONIA) PILULOSA, *Stoliczka*. Pl. IV, Fig. 5.

Cyp. testa ovata, antice atque postice sub-rotundata, lævigata, dorso valide inflato, gibboso, lateraliter subcompresso, anfractibus occultis; apertura lineari, antice paululum expansa atque ad extremitates effusa, prope recta; labro labioque denticulatis, primo ad peripheriam anteriorem angulatim inflexo.

Shell ovate, gibbose, laterally somewhat compressed and with roundish extremities, being slightly produced and notched; surface smooth, polished; the whorls perfectly concealed. The aperture is nearly straight, narrow, widening anteriorly, where the margins on both sides become thinner and sharper. The outer lip is somewhat extended, rapidly and angularly inflexed, finely denticulated on its entire length: the dentition on the inner lip being only partially visible in our specimens.

The lateral compression, combined with the gibbose form and the extension of the outer lip, characterizes this species very well. The *Cypræa involuta* (*Marginella* id. Zek., vide Revision der Gosau-Gastropoden, Sitzungs. d. Akad. Wien. 1865,

Vol. LII, p. 64,) from the Gosau deposits of the Eastern Alps is, no doubt, the nearest ally to our Indian form, and, so far as I know the single specimen of the former, it differs by being anteriorly slender and more produced. Better materials, when procured on both sides, will make a closer comparison of these two forms unavoidable.

Locality.—Near Moraviatoor in Trichinopoly district; only two specimens are as yet known.

Formation.—Ootatoor group.

3. CYPRÆA (LUPONIA) NEWBOLDI, *Forbes*. Pl. IV, Figs. 2 and 3.

1846. *Cypræa Newboldi*, Forbes, Trans. Geol. Soc., Lond., VII, p. 134, Pl. XII, Fig. 21.
 1847. *Ovula incerta*, D'Orbigny, Voy. Astrolabe et Zélée, Paléont., Pl. IV, Figs. 7 and 8.
 1850. „ „ D'Orbigny, Prod. II, p. 225.
 1861. „ „ Gabb. in Proc. Amer. Phil. Soc., Vol. VIII, p. 121.
 1864. „ „ Pictet. Mat. p. 1. Pal. Suisse, Foss. Ste. Croix, 3me. ser. 2me. pt., p. 687.

Cyp. testa pyriformi, globosa, postice subobtusa, antice breviter attenuata, vix emarginata, lævi, polita, anfractibus occultis; apertura subangusta, antice dilatata, utrinque denticulata; labro inflexo, crasso, rotundato, postice extenso, antice intus insinuato, tenuissimo; labio calloso, antice sinuato atque plica elevata terminante, lateraliter compresso et acuto.

The shell is distinguished by its strong globosity, being anteriorly not much produced. The whorls are perfectly concealed and the place of the spire is indicated by a slight impression only; the surface is smooth and polished. The aperture is slightly curved, narrow above and nearly of double the width near the anterior extremity, where it is slightly notched, while the posterior channel turns quite upwards towards the dorsal convexity, exactly as in living species of *Luponia*. The outer lip is considerably thickened, posteriorly somewhat expanded, inflexed in its entire length and internally denticulated; near the anterior canal, where the aperture widens, the outer lip and equally the inner are much thinner, laterally compressed and forming more or less sharp ridges. The dentition of the inner lip is somewhat stronger near the anterior termination than in the middle and posteriorly; at the anterior canal the lip terminates with a strong fold, which can be traced all the way inside along the base of the spire; the next tooth is also somewhat longer, and both these are separated by a deeper insinuation from the other teeth. These characters also quite agree with those of living *Cypræa*. Gray regarded the inner fold along the anterior canal of greater importance than seems necessary, and established his sub-genus *Naria*, which, if based upon that peculiarity alone, must again be abandoned.

Specimens which are devoid of the shell-surface are more globular, because the anterior portion, being very thin and consisting nearly all of shell, is lost in the cast. We have figured (Pl. IV, Fig. 3) one of those casts, which also exhibits the impressions of the marginal dentition in the aperture very clearly. A similar

specimen, or, at least one with obliterate and partly destroyed shell-surface, appears to have been figured by D'Orbigny as *Ovula incerta* (loc. cit.). It is remarkable with what firmness this great French naturalist insisted upon the idea, that there are no cretaceous *Cypræa*. It seems as if he had not given in the above figure the ventral view, because it appeared to him to resemble too much a true *Cypræa*, which doubt he attempted to express in the name *incerta*. The covering of the ventral side with rock probably made its exposure impossible, and so left him in doubt.

Localities.—Kullygoody and near Andoor in Trichinopoly district; several specimens were examined.

Formation.—Trichinopoly group.

4. *CYPRÆA* (LUPONIA) *CUNLIFFEI*, *Forbes*. Pl. IV, Fig. 4.

1846. *Cypræa Cunliffei*, Forbes, Trans. Geol. Soc., Lond., VII, p. 134, Pl. XII, Fig. 22.

1850. *Ovula antiquata*, D'Orbigny, Prod. II, p. 225, in parte.

Idem Gabb, Pictet, etc.

Cyp. testa elongate ovata, cylindracea, lævigata, utrinque emarginata; anfractibus occultis, spira in superficie impressione lævi notata; apertura angustissima, antice dilatata, dentata; labro prope recto, postice attenuato, antice insinuato atque acuto; labio plicosc-dentato.

This species differs from the former, the *Cypræa Newboldi*, by its more slender and cylindrical form, and comparatively much narrower aperture. The surface is in our specimen smooth, exhibiting occasionally striæ of growth. The spiral (transversal) striation referred to by Professor Forbes is not to be observed in any of our specimens. If this striation is actually present on the enameled surface of the shell, the species will be probably better referred to *Trivia*, Gray, belonging to the sub-genus *Pustularia*. With this the somewhat more produced anterior and posterior extremities and the dense, fold-like, dentition of the inner lip are rather in conformity, which characters sufficiently justify the separation of this form from *Cypræa Newboldi*. The anterior canal is also more distinctly emarginated and the posterior shorter, than in the latter species. Forbes' figure represents a comparatively somewhat shorter specimen on account of its being either a cast, or, at least, partially devoid of the enamel coating; otherwise the dentition must have been visible.

Locality.—Near Veraghoor in Trichinopoly district; three specimens were examined.

Formation.—Arrialoor group.

5. *CYPRÆA* (? *LUPONIA* OR *EPONA*) *ANOMALA*, *Stoliczka*. Pl. IV, Fig. 6.

Cyp. testa inflata, ovato-globosa, lævigata, polita, sinistrorsa, extremitate anteriori abrupte contracta, emarginata; apertura angusta, lente S-formi curvata; marginibus utrinque dense striato-dentatis; labro rotundato, antice paulum applanato.

The shell of this species is remarkably globular, being abruptly contracted at both ends. The anterior extremity is short, deeply notched, and somewhat bent back, or upwards. The posterior extremity is unfortunately devoid of the shell-surface on our specimen; it appears to have been, however, similarly formed to the anterior; the spire was perfectly concealed. So far as we are aware, this is a singular unique specimen of a *sinistrorse Cypræa*; the surface of its shell appears to be polished and smooth. The ventral portion of the shell is convex, as in Gray's sub-genus *Luponia*. The aperture is equally narrow along its entire extension, being slightly curved anteriorly towards the spiral side and denticulated on either margin. The teeth appear to be equal in number on both margins, and they are all equally thick, resembling more elongated striæ. Those on the inner lip do not reach far inside, while those of the outer margin extend internally, so far as this is inflexed. On the anterior extremity the portions of the lips are somewhat flattened and the teeth much shorter and smaller. From this striated denticulation of the margins of the aperture, combined with the entire form of the shell, this species will be probably more correctly referred to *Epona*, a sub-genus of *Trivia*, Gray; better specimens are, however, required for such a step.

Locality.—Near Vylapaudy in the Trichinopoly district the single figured specimen was found.

Formation.—Arrialoor group.

6. *CYPRÆA KAYEI*, *Forbes*. Pl. IV, Figs. 7—10.

1842. *Globiconcha ovula*, D'Orbigny, Pal. franç. ter. crét. II, p. 145, Pl. 170, Fig. 3.

1846. *Cypræa Kayei*, Forbes, Trans. Geol. Soc. of Lond., VII, p. 133, Pl. XII, Fig. 20

1850. *Globiconcha ovula* and *Ovula Kayei*, D'Orbigny, Prod. II, pp. 220 and 225.

1853. *Cypræa ovula*, (D'Orb. sp.) Coquand, Journ. de Conchyl., p. 439, Pl. 14, Fig. 1. (non. id. Lamck.) *idem* Gabb in "Synopsis" of cret. foss.; Pictet in Pal. Suisse, etc.

Cyp. testa convoluta, elongate-ovata, cylindracea, lævigata, spira anfractibus circiter quinis conspicuis composita, plus minusve elevata; apertura angustissima, antice expansa, emarginata; labro crasso, rotundate-inflexo, intus denticulato, antice multo tenuiore, subacuto; labio calloso, lamellam crenulatam dentatamque formante.

Not without repeated consideration do we venture to identify our Indian fossil with the long-known European species, an imperfect cast of which was first described by D'Orbigny as *Globiconcha ovula*, and which afterwards has been proved by Coquand to be a true *Cypræa*. A full description is given by Coquand (loc. cit.), and we shall restrict our remarks merely to some peculiarities of the forms occurring in South India.

All our specimens are casts devoid of the shell, except one specimen (Fig. 7), which has the inner lip partially preserved. The callosity forms a thickened lamella, which is provided with numerous short teeth, disappearing rapidly towards the interior, so as to leave scarcely a trace of dentition, when broken away very close at the margin. A similar form of the teeth on the margins of the aperture may be seen in the recent *Cypræa testudinaria*. The anterior portion of the shell is considerably narrowed, the margins being so much compressed, that there is a very small space left internally to be filled with the rock. On the cast this lamellar anterior extremity, as observed in Coquand's figure, generally breaks away, but traces of it are visible on our specimens from South India. The posterior termination of the outer lip shows a bending somewhat upwards, and indicates a similar form of the posterior canal. The comparison of our figures of four different specimens will show, however, that the elevation of the spire increases with the size of the specimen, none of which are as broad as Professor Forbes' figure of *Cypræa Kayei*. From Forbes' description of faint lines of growth it appears, that the specimen had the shell partly preserved, and must have been, therefore, broader; but the enamel surface was certainly either not developed or wanting, otherwise the teeth of the aperture would have been visible; and equally the anterior extremity could not have been perfect, otherwise the margins were not so united as the figure represents them.

This species seems to be a true *Cypræa* in Gray's restricted sense of the genus. It appears impossible to give any strictly specific distinction between the South Indian and the European form, and we can at present only believe in their identity; we retain Forbes' name, because that of *Cypræa ovula* has been by Lamarck used for a living species.

When we compare Reuss' figure of *Strombus ventricosus* (*vide* Versteinerungen d. Böhm. Kreide, 1845, Pt. I, p. 46, Pl. 9, Fig. 11) with that of Coquand, we find the form of both to be very nearly the same. The anterior extremity of the former is broken away, and the bending of the posterior termination of the outer lip indicates a posterior canal. The occurrence of the species in *Hippuritic* limestone agrees very well with the mode of living of *Cypræa*. Geinitz (Quadersandst, p. 138) identifies the *Strombus ventricosus* of Reuss with *Cypræa bullaria*, Schloth. from Faxæ. In comparing Sowerby's figure (Trans. Geol. Soc., Lond., V., Pl. 18, Figs. 1—3) of the latter species with our Figs. 7 and 8, it may be observed, that they equally differ very little in form, as the spire in small specimens is scarcely elevated at all. We have at present no other object than to refer to those similarities which are suggestions merely; but we do not hesitate to state, that there would be little reason for surprise, if all these forms were shown to be identical.

Localities.—Near Andoor and S. of Serdamungalum in the Trichinopoly and near Arrialoor in the Arrialoor-group; the species is rare, only five specimens having been as yet found. The two first-named localities are close to the boundary of both groups, and they also may probably belong to the latter.

Formations.—Trichinopoly and Arriallor groups. In France *Cypræa* (*Ovula*) *Kaye* is quoted from D'Orbigny's Senonien, or the White Chalk.

VIII. ERATO, *Risso*. 1826.

Er. testa ovali, convoluta: spira conspicua, brevi; ultimo anfractu plus minusve pyriformi, maximo; apertura angusta, antice atque postice emarginata, seu sub-canaliculata, labro intus denticulato, labio antice plicose-dentato, postice edentulo.

H. and A. Adams, Chenu, and others separate the genus *Erato* from *Cypræa* altogether, and place it with *Marginella*, &c., in the family *MARGINELLIDÆ*. Even Reeve in his latest monograph of this genus (*Conch. Icon.*, 1865) says:—" *Erato* is a form of *Marginella*, in which the columella, like the lip, is not sculptured until it arrives at maturity." This is certainly in conformity with *Cypræa*, and not with *Marginella*, with which also the enamel covering of the shell does not agree. Hörnes (*Foss. Moll. Wien. I*, p. 77) pointed out very correctly the differences between the shells of *Erato* and *Marginella*. The former, he says, does not possess any actual plicæ on the columellar margin (as *Marginella* very distinctly does), but only somewhat elongated teeth, for which the term 'obsolete plicata' has been used. Hörnes further drew attention to the great similarity of the shell of *Erato* with that of a young, or rather not full-grown, *Cypræa*; indeed, in comparing, for instance, specimens of *Cypræa asellus* or any allied species,—before they are quite full grown and when the enamel covering is not yet very thickly secreted, the spire somewhat conspicuous, and the teeth of the inner lip not much developed,—the similarity of such specimens to shells of *Erato* is so striking, that nobody would hesitate to regard *Erato* merely as a form of *Cypræa*. It appears as if the animals of the former had been by some cause or other stopped in the progressive development of their shell, while *Cypræa* made a step farther and secreted so much enamel as to cover the entire spire, by which character alone some species of *Luponia* differ from *Erato*.

In my revision of the Gastropoda of the Alpine Gosau formation I have observed, that the *Cyprææ* of the older formations (not beyond the cretaceous) show very often an elevated spire, and that the margins of their aperture have often a finer dentition than in living species. Overlooking the deficient state of preservation, which makes the true characters of *Cypræa* often rather obliterate, the elevation of the spire in several eocene and cretaceous species is certainly not always accidental, and seems actually to indicate a certain state of imperfection in the development. I do not mean to convey by this remark, that the cretaceous or eocene species with conspicuous spire ought to be referred to *Erato* on account of this single character alone, but when the surface of the shell, as far as can be distinctly observed, appears quite perfect, not enveloped by the callosity of the last volution, and when the middle and posterior portions of the inner lip do not show a trace of dentition, as in the species we are about to describe here, there seems to be a necessity to refer the same to *Erato* rather than to *Cypræa*. The single objection which could be

raised in our case of the Indian species is, that it has the posterior canal more strongly marked than is usually observed in the living species of *Erato*.

As regards the classification of *Erato* next to *Cypræa*, we need hardly remark further, that the animals of both are very similar, as was long since shown by the first detailed descriptions of Philippi. Gray (Guide to Moll. Brit. Mus., 1857, p. 74,) says, "this genus (referring to *Erato*) differs from *Marginella* in having a rostrum or proboscis."

L. Reeve in his monograph of *Erato* (Conch. Icon., 1865) describes 18 species, of which he states that their geographical distribution is quite different from that of *Marginella*. Six species of tertiary fossil *Erato* are recorded, including the three lately noticed by Deshayes from the Paris basin (Tom III, p. 556), and of these six species *Erato lævis* occurs also recent in the Mediterranean Sea. From the cretaceous rocks the following species is, we believe, the only one as yet described:—

1. ERATO VERAGHOORENSIS, *Stoliczka*. Pl. IV, Figs. 13 and 14.

Erato testa pyriformi, inflata, antice attenuata, in superficie lævigata, spira brevi, acuminata; apertura angusta, S.-formi, ad extremitates effusa; labro rotundate inflexo, postice expanso, interne crenulate-denticulato; labio antico planato, et ad marginem anteriorem dentato.

The young shell is elongated, ovate; the adult, by becoming posteriorly more inflated, globose, and being at the same time attenuated anteriorly acquires a pear-shaped form: the surface is smooth and polished. The spire consists of five or six volutions, and is so little prominent, that it measures only about one-seventh or one-eighth of the total length of the axis. The outer lip is thickened, at the posterior extremity expanded, ear-shaped, along its entire length inflexed, and on the interior margin densely and finely denticulated. The inner lip is on the columellar place flattened, bearing on the lower or inner margin a few small roundish teeth. The aperture is narrow, slightly S-form, canaliculated on both ends.

Besides the very characteristic form and the expansion of the posterior portion of the outer lip, the dentition of this species is remarkable, the teeth not being in any way elongated, as usually in the genus *Cypræa*, but more roundish, isolated, placed exactly on the sharp margins of the outer and of the anterior portion of the inner lip. On the other hand the posterior canal is equally peculiar, being turned perfectly upwards, bounded by a thickening of both lips, as usually seen in *Luponia*, but rarely in *Erato*.

Locality.—Near Veraghoor, in Trichinopoly district; four specimens have been examined, but none of them has the anterior canal perfectly preserved.

Formation.—Arrialoor group.

III. *Family—OLIVIDÆ.*

The *OLIVIDÆ*, represented by the well-known genera *Oliva* and *Ancillaria*, are, as regards structure and form of shells, most nearly allied to the *CYPRÆIDÆ*, and form (through the sub-family *HARPINÆ* and the family *DOLIIDÆ*) a passage to the *CASSIDIDÆ*. The animals of the *OLIVIDÆ* are to some extent like young *CYPRÆIDÆ*, inasmuch as they have in front a kind of mantle-lobe, which also resembles that of the animals of the *TOENATELLIDÆ* and *BULLIDÆ*. In the *CYPRÆIDÆ* this mantle-lobe disappears totally, or very nearly so, while in the *OLIVIDÆ* it develops itself rather more strongly with advancing age. The dentition forms a marked difference in these two families.

The existence of the anterior and posterior filamentose process and the enclosure of the latter in a separate groove at the suture admits of a convenient separation of the family into two sub-families, *OLIVINÆ* and *ANCILLARINÆ*. Gray includes in this family the genus *Harpa* as a sub-family also, *HARPALINÆ* or rather *HARPINÆ*, and, as the animals of *Harpa* do not seem to differ essentially, this classification appears acceptable.

The fossil species of the *OLIVIDÆ* do not date earlier than the cretaceous period. Of the *OLIVINÆ* three and of the *ANCILLARINÆ* two species are known from these deposits.

a. *Sub-family—OLIVINÆ.*

The first species of the *OLIVINÆ* was described by Professor Forbes from the South Indian cretaceous rocks as *Oliva vetusta* (Trans. Geol. Soc., Lond., VII., p. 134, Pl. 12, Fig. 23). Mr. H. Blanford (Mem. Geol. Surv., IV., p. 141,) mentions that an *Oliva* occurs in the Arrialoor beds at Ninnyoor; but we have not seen a trace of this shell, and cannot therefore pronounce an opinion on it. Forbes' species appears to belong to *Olivella*, but it may be premature to make such changes, before well-preserved specimens have been examined.

The second species is *Oliva prisca*, Binkhorst (Monog. Gastr. et Ceph. craie sup. de Limbourg, 1861, p. 71, Pl. V, A 2, Fig. 14) from upper cretaceous beds; the species is based upon an imperfect cast, and appears rather doubtful; it could quite as well be a cast of a *Cypræa* or *Erato*.

The third species, *Olivella Mathewsonii*, was lately noticed by W. Gabb from the cretaceous deposits of California (Pal. of Calif., I, 1864, p. 100, Pl. 18, Fig. 53).

b. *Sub-family—ANCILLARINÆ.*

The two as yet known species belonging to this sub-family are *An. cretacea*, Müller (Petref. d. Aachner Kreide, 1851, p. 79, Pl. VI, Fig. 23) and *An. elongata*, Gabb. (Pal. Calif. I, 1864, p. 100, Pl. 18, Fig. 54).

c. *Sub-family—HARPINÆ.*

No cretaceous fossils, belonging to this sub-family, have as yet been reported. There are about five tertiary and fifteen recent species of *Harpa* known.

IV. *Family*,—*DOLIIDÆ*.(Vide H. and A. Adams, *Genera*, p. 195; Gray's *Guide*, 1857, p. 40.)

There are usually only two genera distinguished—

1. *Dolium*, Lamk. 1801 (? Browne).
2. *Malea*, Valenc. 1833 (*Oidium* apud Adams).

The second genus forms through its thickened outer-and inner-lips a transition to the *CASSIDIDÆ*. The *DOLIIDÆ* are almost uniformly distributed, but sparingly represented in the temperate and tropical waters; there are at present only 22 recent species known; the number of the tertiary fossil species does not much exceed half that of the recent ones, and from cretaceous beds there has been only one species described by Sowerby (*Min. Conch.*, Vol. V. p. 34., Pl. 426 and 427) as *Dolium nodosum* from the lower chalk of Clayton in Sussex. D'Orbigny transferred the species to *Strombus*, as *St. nodulosus*—and Pictet and Campiche (*Mat. p. 1. Pal. Suisse*, 3me. Ser. Foss. Ste. Croix., p. 583) are of opinion, that it is most probably a *Pterocera*, which from its resemblance to *Pterocera incerta*, D'Orb. certainly appears very likely to be the case. Unless, however, this supposition is confirmed by new discoveries, any such alterations can only be provisional.

V. *Family*,—*CASSIDIDÆ*.

Shell ventricose, spire short, the last volution enveloping the previous to a great extent; aperture elongated, generally narrow; margins more or less thickened and toothed or plaited; anterior canal generally distinct, short and re-curved upwards; posterior canal seldom distinct, usually only indicated by a depression on the margins. The surface of the shell is generally richly ornamented with spiral sulci or transverse, often interrupted, ribs.

The animals are not less characteristic than the shells. They have mostly a long neck with not very distinct head, long proboscis and tentacles with the eyes on the outer side, sessile on well developed short bulgings. As regards the dentition they are *TÆNIOGLOSSA* (Gray). The foot is generally large and dilated, resembling that of *Ranella* and *Tritonium*, the former genus being (*in parte*) placed by Gray in this family. The animals of *Ranella* and some genera of the *Cassididæ* are in fact nearly identical, but the shells exhibit some very noteworthy differences, which do not seem to be in favour of Gray's classification of *Ranella*. It is indeed difficult to assign a proper transitional place to this family. The animals appear to form directly a passage from the *CYPRÆIDÆ*, *OLIIDÆ* and *HARPIDÆ* to the *TRITONIDÆ*, *BUCCINIDÆ* and *MURICIDÆ*, while the shells of several forms of the *CASSIDIDÆ* are undoubtedly most nearly allied to the *PLEUROTOMIDÆ*, for which reason we have placed them here.

Although the *CASSIDIDÆ* by no means belong to the category of rare shells, there still exists so much controversy as regards the number and names of the

genera to be admitted, that it appears best to treat the fossil forms under the more general terms *Cassis*, *Cassidaria* (*sensu Lamarcki*) and *Oniscia*, Sowerby. This course is also strongly advocated by Deshayes in his last contribution to the Paris fossils (Tom. III, pp. 471, &c.), and it may at present do well enough for the fossil forms; although there can be no question, that some system of classification, of the recent species of *Cassis* and *Cassidaria*, as proposed by H. and A. Adams, Gray and others, must be adopted, as otherwise it would certainly be impossible to give a strict definition of the group. Chenu, Gray and others add *Pachybatron*, Gask. and *Cythara*, Shuhm. to this family; the latter genus seems to be, however, more properly placed in the family *PLEUROTOMIDÆ*, as will be found stated more fully hereafter.

The number of fossil species of *CASSIDIDÆ* is not very large in the tertiary deposits (see Deshayes, Tom. III, pp. 474 and 482), and in the secondary, it is very limited. The *Cassis corallina*, Quenstedt, from the Nattheim coral-rag having been proved by Dr. Rolle to belong to the family of *COLUMBELLIDÆ* and separated as a distinct genus under the name of *Columbellaria* (see the family *COLUMBELLIDÆ*), the earliest true representatives of the *CASSIDIDÆ* are met with in the cretaceous deposits. Of *Cassis* no cretaceous species has been as yet reported. Of the section *Cassidaria* three species are known, *C. cretacea*, Müller (Monog. d. Petref. d. Aachner Kreide, 1851, II pt., p. 17, Pl. III, Fig. 21); *Morio tuberculatus*, Gabb. (Pal. Calif. 1864, I. p. 104, Pl. 19, Fig. 57); and *Sconsia Alabamensis*, Gabb (Jour. Acad. Phil. 1860, IV, p. 801, Pl. 48, Fig. 13). This last named species is doubtful, but the two other appear to be true *Cassidariæ*. Of *Oniscia* we have to notice the first cretaceous species described. It has been found represented in a comparatively well preserved specimen, so as to leave little doubt as to its generic determination, and in beds attributed by Mr. H. Blanford to the highest division of the South Indian cretaceous deposits.

IX. ONISCIA, Sowerby, 1825.

The principal character of this genus, as distinctive from the *Cassidariæ*, lies in the granulation of the thickened inner lip. It is hardly necessary to say, that the scarcely known name of Bolten, *Morum*, cannot compete with the universally known *Oniscia*, nor do I see any particular use in distinguishing the genera (*Oniscia* and *Morum*, Gray; *Morum* and subgenus *Oniscidia*, Adams and Chenu.) The difference between *Oniscia* and *Morum*, as stated by Gray (Guide, 1857, p. 70) reduces itself respectively to a plaited or denticulated outer lip, the limit of which character varies with the age of shells of one and the same species. I can scarcely believe, that the animals could show any such essential difference as to support the necessity for two genera. The cretaceous species, which we refer to this genus, has the same form and a granulated thickened inner lip like other *Onisciæ*. The canal is produced, and recurved, the outer lip reflexed and rounded with a thickened margin exteriorly as in *Oniscia* proper (according to Gray), but it is toothed internally, as in *Morum* (apud Gray).

1. *ONISCIA COSTELLATA*, *Stoliczka*. Pl. V, Fig. 9.

On. testa ovali, antice caudata, postice apice acuta; anfractibus 6-7, scalariformibus, ad suturam posteriorem valde constrictis, transversaliter costulatis: costulis acutis, prope rectis, circiter 18 in uno circuitu; apertura angustissima, lineari, labro ad peripheriam valde incrassato, interne denticulato, labio calloso, postice acuminato, elevato, dense crenulato; canali moderato, recurvo.

Width of the last whorl : height (consd. as 1·00)	...	...	0·68
Height of aperture : total height of shell (consd. as 1·00)	...	...	0·63

Shell elongated, considerably tapering towards each end, consisting of six or seven volutions, the last of which by far exceeds the previous in size, so as to form about three-fifths of the total height of the shell. On the upper or posterior suture the whorls are much constricted, each ornamented with about 18 nearly straight and sharp transverse ribs. Of spiral striæ there are scarcely any traces perceptible, and they must have been very fine. The aperture is very narrow and oblique, forming a slight curve. The outer lip is at its margin, and especially at the outer edge, very thick, little expanded and reflected, internally in its entire length denticulated; the inner is callose, especially posteriorly near the suture, where it is considerably elevated, covering the greater part of the front or ventral side of the last whorl; it is all over finely crenulated and, in the middle of the space of the aperture, slightly insinuated. The canal is proportionally long, thin, recurved and on the termination emarginate.

The somewhat inflated form in the middle of the shell, the sharp transversal ribs, the prolonged and recurved canal, the narrowness of the aperture and the want of the insinuation on the outer lip distinguish this species without difficulty from *Cythara cretacea*, n. sp., even when the inner lip or its granulation is not well preserved.

Locality.—South of Arrialoore in Trichinopoly District, where the single figured specimen was found.

Formation.—Arrialoore group.

VI. *Family*,—*PLEUROTOMIDÆ*.

(*TURRITIDÆ*, Adams, *non* Gray.)

The common character of the different genera usually admitted into this family, reduces itself to *fusiform shells with a posterior notch on the outer lip*.

The animals are all very similar; they have an oval and simple foot, enclosed mantle, approached subulate tentacles, with the eyes on the outer side near the base or the middle; subulate, elongated teeth etc., all characters in which they resemble the *CONIDÆ*. Deshayes was among the first who drew attention to the relations of *Pleurotoma* and *Conus*. The newer observations of the animals by Quoy,

Forbes and Hanley, Gray and others, support very much this view. There are in fact, especially among the fossil forms of *Pleurotoma*, species, which have such a short spire compared with the last volution, that they resemble most closely the slender and elongated species of *Conus*. The slit near the posterior termination of the outer lip is equally not unlike in both. I would recall only *Pl. mitraeformis*, Kien. and *Con. stromboides*, Lam. respectively. Similarities like these and others may induce Deshayes to unite *Pleurotoma* and *Conus* into one family *CONIDÆ*, as proposed by Woodward. Of course this speaks for itself, since Deshayes does not much consent to a further division of the genus *Pleurotoma* in Lamarck's sense, but I believe it quite impossible to retain such a unity at present, as opposed to the late progress in conchological science. It is no doubt remarkable, that those species of *Pleurotomæ*, which are most nearly like in form to *Conus*, have the eyes near the middle of the tentacles, those with a more elongated and fusiform shell have the eyes at the base, like the *FUSINÆ*, and so we have an equal relation to both.

Gray, in his Guide of 1857, treats the family *PLEUROTOMIDÆ*, as regards the teeth of the radula, with the *CONIDÆ* in his sub-order TOXIFERA, and this seems to be their best place, although I would for my own part not have greater confidence in the dentition, than in the other points of relation. H. and A. Adams refer their *TURRITIDÆ* to the RACHIGLOSSA, next to the *FUSINÆ* of the family *MURICIDÆ* to which the true *Pleurotomæ*, as regards their form, are no doubt most closely related.

Adams, Gray and others agree in dividing the *PLEUROTOMIDÆ* into three sub-families, namely *CLATHURELLINÆ*, *CLAVATULINÆ* and *PLEUROTOMINÆ*.

a. The names *CLATHURELLINÆ* and *Clathurella*, Carp. respectively, have been supplied by H. and A. Adams in the corrections (Genera, Vol. II. p. 654) for the previously applied name *DEFRANCINÆ*, as the name *Defrancia*, Millet, 1826 (1827?), must be abandoned, because the same had been used in 1825 by Bronn for a genus of the Bryozoa. The genera of this sub-family are very much related to the *CASSIDIÆ*, but most conchologists treat *Cythara*, Shum. in this sub-family, while others follow Gray's classification of this genus with the *CASSIDÆ*. We would only here draw further attention to the animal of *Cythara*, inasmuch as it has posteriorly a pointed, not a trunked, foot like most other *PLEUROTOMIDÆ*; otherwise there seems no reasonable ground for a separation. It is of course very desirable, that many more animals were observed and examined, and it may be then found, that several alterations are to be admitted in this sub-family. There is only one species in our Indian collection belonging to this group of shells; it will be found described as *Cythara cretacea*, n. sp.

The genus *Clavatula* is accepted by Deshayes in his last edition of the Paris fossils, III., p. 340. *

b. The *CLAVATULINÆ* have an operculum with a latero-central nucleus.

c. The *PLEUROTOMINÆ* have an operculum with an apical nucleus; they are mostly elongated fusiform shells.

In this sub-family we have to mention one genus, which is represented in the cretaceous fossils of the South Indian deposits. There exist still great differences as to the defining of the different genera of the *PLEUROTOMINÆ*, as may be seen on a review of Adams's, Carpenter's, Gray's, Chenu's and others' researches. We had already occasion to state, (Sitzungsb. Akad. Wien., 1865, Vol. LII, Revision &c., p. 86) that there is no hope of arriving at any satisfactory understanding on this point, unless the very numerous fossil species are included in such a classificatory attempt. Even greatly increased anatomical researches will in this case not bring the point in question much farther.

a. Sub-family,—*CLATHURELLINÆ*.

X. CYTHARA, *Shuhmacher*, 1817.

(Vide Adams' Gen. I. p. 98; *Cithara**, Gray's Guide, 1857, p. 40.)

H. and A. Adams remark, that "in the slight dilatation of the mantle margin, in the short spire, and in the corrugated inner and thickened outer lips," this genus "somewhat resembles *Morum* (*Oniscia*) among the *CASSIDIDÆ*." Gray places *Cithara* (= *Cythara*) actually in the last named family, that is, next to *Oniscia* in one sub-division.

I may first remark, that I compare our fossil species only with those typical forms of *Cythara*, as *Cyth. marginelloides*, *citharella*, *stromboides* and others, but I am not prepared to say, whether all the species quoted by Adams under *Cythara* should remain within the limits of this genus. In comparing the cretaceous species here under description with *Cyth. marginelloides*, it is instantly apparent, that no reasonable ground can be given for a generic separation of the two species, inasmuch as the general form is nearly the same, the inner lip corrugated, the outer lip thickened, toothed internally, and posteriorly with an insinuation of the margin.

When we farther compare the two oldest known species of *Oniscia* and *Cythara* respectively, as here stated and figured on Plate V, we see that they agree very much in the form and structure of their shells, that the corrugation and partial granulation of the inner lip of the *Cyth. cretacea* is at least remarkably like that of *Oniscia costellata*, and that the thickenings of the outer lip with the blunt exterior edge are formed in a perfectly identical manner in both; but that the margin of the outer lip of the *Cythara* has posteriorly a sinuosity, and so still retains the principal character not only of the genus, but at the same time that of the entire family of the *PLEUROTOMIDÆ*, as I have previously remarked. It must be said, that the insinuation of the outer lip is an essential character of the *PLEUROTOMIDÆ*, as also partially of the *CONIDÆ*. A second very marked character in our cretaceous species and in most other living species of *Cythara* is the straightness of the anterior canal, which in all *CASSIDIDÆ* is constantly recurved or turned upwards. As the

* From Mr. Mörch's notes on a few of Link's genera it would appear, that *Cithara*, Klein, is the same as *Harpa*, Lam., and that there ought to be two sub-divisions established *Harpalis*, Link (*H. antiquata*), and *Harpa* Lamk. (*H. costata*). (Proceed. Zool. Soc. Lond, 1862, p. 227.)

result of the examination of the two oldest species of *Oniscia* and *Cythara*, I may therefore record, that while both of them show very remarkable affinities in the general growth of the shell to each other, each of them separately retains still the typical characters of its respective family. Unless, therefore, it could be proved by anatomical researches on the animal of *Cythara*, that it has very little in common with the organization of the *PLEUROTOMIDÆ* (apparently a very improbable case) and that it agrees much more with that of the other *CASSIDIDÆ*, Gray's proposed classification of this genus in the latter family cannot be accepted.

One point may be worthy of notice. Gray quotes among his distinctions between *Oniscia* and *Morum*, that the outer lip of the former is reflected and rounded (in front!), while in the latter it has a shelving outer edge. The outer lip of *Cythara* has also a shelving outer edge, while in the cretaceous species, which we describe, the outer lip is reflected, rounded in front, and with a blunt, broad outer edge. It would appear, therefore, that there exists a similar difference between the *Cyth. cretacea* and the living species of *Cythara*, as between *Oniscia* and *Morum* of Gray; but I have already stated, that this difference between *Oniscia* and *Morum* appears to me to be so much subject to variations during the age of even one and the same species, and depending so much upon the localities and modes of life of the species, that I do not think it can be fairly used as a generic distinction. The fact is, however, worthy of record, and it is possible that some further enquiries may prove to be in favour of this reported distinction, as our knowledge daily advances.

It is difficult to say anything about the fossil species of *Cythara*, although they are not wanting either in the neogene or eocene deposits; they are all described under *Pleurotoma* or *Mangelia*. A similar remark applies to the cretaceous species, although, if the *Pl. arata*, Gabb (Proc. nat. sc. Phil. for 1860, p. 198, Pl. 3, Fig. 9) does not belong to this group, I am not aware of any other, which would bear approximately the characters of the genus.

1. CYTHARA CRETACEA, *Stoliczka*. Pl. V., Fig. 10.

Cyth. testa elongate-ovata, spira brevi, acuminata, anfractibus subconvexis, 4-5, striis spiralibus atque costulis transversalibus cancellatis, ultimo spira multo longiore; canali brevi, vix curvato, antice late emarginato; apertura ovali, antice atque postice subacuta; labio calloso, ultimum anfractum infrá partim tegente, ad marginem internum papillose crenato; labro parum extenso, ad peripheriam incrassato, prope terminationem posteriorem late insinuato, intus anticeque undulate dentato.

Width of the last whorl :	total height of shell (considered as 1.00)	...	0.45
Height of aperture :	ditto	ditto	.. 0.69

An elongated ovate shell, convex above and somewhat flattened below, the last whorl enveloping the previous to a great extent and occupying somewhat more than two-thirds of the total height. The convexity of the whorls is not considerable, and their surface is cancellated by spiral striæ and transversal ribbings. The

former are very numerous and nearly all of equal strength and equally distant, some very fine ones being occasionally intermingled between the others. The transverse ribs are somewhat stronger and broader, resembling periodical accumulations of striæ of growth; they are slightly flexuous on the last volutions. The aperture is oval, pointed at each end, callose internally. The outer lip is a little expanded and thickened, on the margin somewhat reflexed, rounded in front and very thick on the outer edge; internally flattened, near the posterior extremity deeply and broadly insinuated, and towards the anterior extremity provided with slight denticulations. The inner lip is callose, apparently not much enlarged and on the apertural margin provided with short papillæ, or partially granulated. The canal is short, broad, very slightly bent to the left side (in front view), and widely emarginated.

The peculiar cancellate ornamentation of the surface, the short, nearly straight and widened canal, the broad but shallow insinuation of the outer lip near the posterior termination and the thick outer edge of the same, are the chief distinctive characters of this species.

Locality.—Near Veraghoor, in Trichinopoly district; the figured specimen is as yet unique.

Formation.—Arrialoor group.

XI. PLEUROTOMA, Lamarck, 1799.

Pl. testa fusiformi, spira turrita; canali longo atque recto; columella lævi; labro posterius sinu emarginato.

We accept here the genus *Pleurotoma* in its restricted sense for the turreted shells with a long and straight canal and an emargination of the outer lip near the suture. The name *Turris*, substituted by Adams for *Pleurotoma*, has been very hastily introduced by American authors into palæontological literature, and with very little reason indeed. H. and A. Adams use (*loc. cit.* I., p. 87.) *Turris*, Humph., instead of *Pleurotoma*, Lamk.; on p. 351 of the same volume they quote *Turris*, Humph., not Bolten, as a synonym with *Turritella*, Lamk., and, on p. 246, they say, that they are indebted for valuable information to Dr. Gray, namely, that the *TURRIDÆ** belong possibly to the sub-order TOXIFERA. If we consult Gray's Guide of 1857 on this point, we find Adams' *TURRITIDÆ* replaced by the usual denomination *PLEUROTOMIDÆ* (p. 7) and under *TURRITIDÆ*, and *Turris* (whose?) respectively some species treated, which the Adams refer to the *CANCELLARIIDÆ* and others. It appears that Dr. Gray has changed his mind since his communication with the authors of the "Genera." Agassiz (in his Nomenclator) quotes the name *Turris*, Humph. 1797, and does not know Bolten's name. Chen and Gabb add to *Turris* the authority, Bolten 1798, and not Humphrey.

* *Vide* Vol. II., p. 614. H. and A. Adams partly correct this misapprehension and call the family *TURRIDÆ* and the sub-family *TURRINÆ*!! Has this change been introduced for the sake of avoiding a confusion with *Turris* and *TURRITIDÆ* of Gray, or merely to correct the expressions in a grammatical point of view?

This shows, I believe, clearly enough, what reason there exists for the adoption of the name and authority of *Turris* against that of *Pleurotoma*, and for substituting this doubtful and obscure name for one which has been familiar ever since naturalists began to look at a shell with a scientific object;—so much for the names *Pleurotoma* and *Turris*.

The number of living and tertiary species of *Pleurotoma* is very great, but there are only few known, which have been described under this name from the cretaceous deposits. Excluding the very uncertain species (vide Pictet, Pal. Suiss. 3 me ser. pt. II p. 655) the following have to be noticed:—

1. *Pl. subfusiformis*, D'Orb., known from the Gosau and from South India; will be described in the following pages.

2. *Pl. fenestrata*, Zekeli, (vide Revision, etc., Sitzungsab. Akad. Wien 1865, LII, p. 87) from the Gosau deposits, belongs probably to *Clathurella*, Carp. (*Defrancia*, Millet.), but is not very certain.

3. *Pl. Heisiana*, Müller, from the cretaceous strata near Aachen, a very peculiar form, which, so far as the figure admits of a definite opinion, has to be classed with *Pl. terebralis*, Lamarck, *Pl. subterebralis*, Bell, *Pl. dimidiata*, Brocchi, and other fossil forms.

To these three European, no less than thirteen American species have to be added, viz.:—

4—16. *Pl. araucaria*, D'Orbigny, Prodr. II., p. 230; *Pl. arata* and *d'Orbignyana*, Gabb; *Pl. contorta*, Meek and Hayden.; *Pl. minor*, E. and Shumard, (Gabb's Synopsis, Proc. Amer. Phil. Acad. VIII, p. 145. *Turris*); *Pl. (Turris) Claytonensis*, and *varicostata*, Gabb, (Pal. of California, I. 1864, pp. 92, 93). The first three are from Chili, the other four from North America. Further *Daphnella?* *Eufalensis*, ? *lintea*, ? *subfilosa*; *Drillia distans*, *novemcostata*, ? *Tippiana*; all species named by Conrad (see Gabb, Synop. loc. cit. pp. 104, 105), from Alabama and Mississippi.

Mesochilostoma is a doubtful genus proposed by H. Seeley in 1861 (Ann. Mag. Nat. Hist. Ser. III., Vol. VII., p. 284) for a species from the upper Greensand of Cambridge. The shell is characterized as *turreted*, with a supposed *short canal*, and *on the outer lip with a notch, which forms a keel round the middle of the whorls*. There are numbers of species known, specially of the *CLAVATULINÆ*, which have these characters perfectly developed. The short description of the species, *M. striata*, given by Mr. Seeley, does not add anything more to the knowledge of the genus, and it is impossible to form a clear idea of either of them.

The following species have to be excluded in addition to those quoted by Pictet and others: *Pl. heptagona*, Zekeli, quoted by Pictet, belongs to *Pl. subfusiformis*, D'Orb.—*Pl. (Turris) involuta*, Goldfuss, mentioned by Gabb in his catalogue, must be referred to the *VOLUTINÆ*; and *Pl. subspinoso*, D'Orb. (ibid.) is *Borsonia spinosa*, Sow. sp. (Stoliczka, Rev. etc. Sitzungsab. Akad. Wien, 1865 Bd. LII. p. 87.) The second known species of *PLEUROTOMIDÆ* with plaited columella is *Cordiera microptygma* (Gabb, Pal. Calif. I. 93).

The total number of cretaceous *PLEUROTOMIDÆ*, although beside those mentioned several others will have to be excluded, would be up to the present time 17, if the American species are actually as numerous as thirteen or fourteen. I have repeatedly gone over the brief descriptions and compared the figures given by Conrad of some of the species of *Daphnella* and *Drillia*, and they certainly appear to me extremely doubtful. Not to say anything of the species, scarcely one of the genera appear determinable with even approximate accuracy.

1. *PLEUROTOMA SUBFUSIFORMIS*, *D'Orb.* Pl. VI, Figs. 1 and 2.

1831. *Pleurotoma fusiforme*, Sowerby, Trans. Geol. Soc., Lond. III, Pl. 39, Fig. 20: (non *Pl. id.* Sow. 1823, Min. Conch. IV, Pl. 387, Fig. 1.
 1850. „ *subfusiformis*, D'Orbigny, Prod. II, p. 230.
 1852. „ *heptagona*, Zekeli, Gasterop. d. Gosau. Abhandlg. d. Geol. Reichs-A. Wien, Vol. I, pt. 1, p. 91, Pl. 16, Fig. 8; non *F. heptagonus*, Sow.
 1853. „ „ Reuss, Sitzungsab. d. Akad. Wien, Vol. XI, p. 915.
 1861. *Turris subfusiformis*, Gabb, Proc. Am. Phil. Soc. VIII, p. 145.
 1864. *Pleurotoma* „ Pictet, Mat. p. 1., Pal. Suisse, 3me Ser. Foss. Ste. Croix. p. 654.
 1865. „ *fusiformis*, Stoliczka, Sitzungsab. Akad. Wien, Vol. LII, Rev. etc. p. 86.

Pl. testa fusiformi, perlonga; anfractibus, numerosis, parum convexis, ad medium subangulatis, supra excavatis, transversim costatis ac spiraliter striatis: costis crassis, nodulosis, supra evanescentibus, striis 4-5, spiralibus transeuntibus ornatis; labro paululum extenso, postice prope suturam profunde sinuoso; canali longo, recto, ad terminationem paululum contorto.

Spiral angle 30°—36°; sutural angle 7°.

Shell very long, consisting of about ten whorls, which are much contracted at the upper suture and slightly angulated near the middle. Each of them is ornamented with nine or ten short and thick transverse ribs, disappearing on the upper portion; they are crossed by four or five spiral striæ. When the surface is well preserved, it presents numerous striæ or lines of growth, which being somewhat elevated like undulating laminæ, give it rather a rough appearance. Near the suture they are strongly bent inward, and accumulate on the same generally to a thickened margin. The last whorl including the canal is about the same length as the spire. The inner lip is thin and smooth, the outer somewhat produced in the middle; the anterior termination of the canal is a little turned.

There are several very similar species known from the neogene and eocene deposits. I would notice only *Pl. Lamarki*, Bell., (Hornes, Foss. Moll. Wien. p. 362, Pl. 39, Figs. 4—7) and *Pl. brevirostrum*, Sow. (Min. Conch. IV, Pl. 387, Fig. 2); it is scarcely possible to give any mark of distinction from the former.

This species was first collected in the Gosau by Sedgwick and Murchison on their early visit to the Alps, and was figured by Sowerby under the name *P. fusiforme* in 1831, which name has been subsequently changed by D'Orbigny. Zekeli in describing the Gastropoda of the Gosau formation, identified the shell with a totally

different species, as I have pointed out in my revision of the Gosau Gastropoda (*loc. cit.*) I have compared our Indian specimens with those from the Gosau, and I am unable to give any distinctions. The form of the shell, number of whorls, the short nodulose, transverse ribs—generally about 9, the thickened spiral striæ, as well as the undulating striæ of growth with their insinuations near the suture agree perfectly. Sowerby's figure is characteristic enough, but that of Zekeff is derived from an imperfect specimen, and has not been very correctly restored.

Localities.—Andoor, Alundanapooram, and near Olapaudy in Trichinopoly district; not common.

Formation.—Trichinopoly group, near the boundary of the Arrialoor,—to which the last named locality refers according to Blanford's map.

VII. *Family*,—*CONIDÆ*.

Idem, Adams, Chenu and others; *CONUSIDÆ*, Gray.

As universally acknowledged, this is one of the most peculiar and interesting families of the Gastropoda. The animals are all very much alike, being laterally compressed in accordance with the narrow inner space of the whorls, with an oblong and undivided foot which is provided with an aquiferous pore on the under surface. The head is produced into a tubular veil, with a retractile proboscis and subulate teeth, placed generally in two series on a prolongation of the proboscis. The tentacles are thickened at the base, close together on the tubular veil, which surrounds the mouth; the eyes are sessile on small bulgings, generally about the middle of the outer side of the tentacles. The siphon is long, recurved, producing an emargination on the anterior extremity of the *reversed conical* shell, *the spire of which is more or less, but never very considerably elevated and pointed*.

From the great peculiarity in the dentition—*TOXIGLOSSA* in Gray's sense—H. and A. Adams describe the *CONIDÆ* as a separate family in the higher division of *TOXIFERA* of Gray. The latter author refers to the same sub-order the *CONUSIDÆ*, *ACUSIDÆ* and *PLEUROTOMIDÆ* (see Guide 1857, pp. 4—7), each of which includes several genera. As regards the first and the last family (*CONIDÆ* and *PLEUROTOMIDÆ*), we think Gray's classification of high value; but we do not accept the *ACUSIDÆ*,—more properly *TEREBRIDÆ*,—and shall refer to this family subsequently towards the end of the *SIPHONOSTOMATA*, near to the *PYRAMIDELLIDÆ*. We believe that the shells of the *TEREBRIDÆ* have a great relation to those of the *PYRAMIDELLIDÆ* and *CERITHIIDÆ*, and even their animals in the form of their locomotive organ, the thick proboscis, small siphon, &c., are very closely allied to *Vertagus* and others. Geological considerations also are more in favour of this latter classification. Deshayes places the *PLEUROTOMIDÆ* and *CONIDÆ* in one family under the last name. (Foss. de Paris, III, 337.)

The *CONIDÆ* have been up to the present, and are still generally described under one genus, *Conus*, Linné. H. and A. Adams divide them into seven genera; Gray retains three; Keferstein, Deshayes and others, two (*Conus* and *Dibaphus*), as

did also Chenu. The latter author enumerates several sub-genera of *Conus*. It is, indeed, difficult to say, without a very extensive knowledge of the different species, whether a division of *Conus*, in the old sense, be necessary or not. What appears to be really the fact, is this, that the division, if necessary, must be very great, based on the principal variations in the form of the shells; otherwise it would be better to have no generic sub-division at all. For my own part, I believe that a farther division, even if slightly indefinite for the present, would be of very great service; and I have no hesitation in saying, that some division similar to, or the same as that proposed by H. and A. Adams, will be quite essential. It is true, so far as our present knowledge goes, that (excluding *Dibaphus*) the animals scarcely admit of any further separation than into *Conus* and *Nubecula* (or *Tuliparia*).

About 300 living species, belonging to this family, are known; of these, nearly one-half are inhabitants of the Eastern Seas. Of tertiary species, which, on the whole, resemble the living forms, about 90 have been noticed. Deshayes describes in his last work 20 species from the Paris basin alone.

Pictet* enumerates six cretaceous species, *C. cenomanensis*, Guéranger, *C. tuberculatus*, Duj. *C. marticensis*, Math. *C. cylindræus*, Geinitz. *C. semicostatus*, Münster, from Europe, and *C. canalis*, Conrad, from America. All these species, excepting the *Conus tuberculatus*, to which we shall refer hereafter, are based chiefly upon casts, not in a peculiarly good state of preservation, and several of them are rather doubtful. In this doubtful state, they must remain until better materials are procured. I could add the *Conus Verneuilli*, Vilanova (Mem. Real Acad. Madrid 1859, Vol. IV, Pl. 3, Fig. 12), which can be as well an *Actæonina*. Gabb has lately described three species from California (Palæontol. 1864, I, pp. 122 and 123), *C. Rémondi*, *C. Hornii* and *sinuatus*, all of which are pretty well preserved and appear to belong undoubtedly to this genus.

It is rather remarkable that we have not a single species of *Conus* to notice from the cretaceous deposits of Southern India, although numbers of them, at the present time, inhabit the Bay of Bengal. The single species procured belongs to another genus of this family, only found fossil, so far as known, and for which I proposed in 1865 the name *Gosavia*.

Of species of *Conus*, older than cretaceous, we know scarcely anything. The jurassic *Con. Cadomensis* and *abbreviatus* of Deslongchamps are referred by D'Orbigny to *Actæonina*, although no decided proof can be given that they are not *Conus*. The *Conus ? minimus* of d'Archiac belongs probably to *Cylindrites* or to an allied genus of the OPISTHOBRANCHIA.

* Pal. Suisse, 3. Ser., 2nd part, 1864, p. 689.

XII. GOSAVIA, *Stoliczka*, 1865.

Sitzungsberichte k. Akademie der Wissenschaften, Wien. Vol. LII, Revision. p. 76.

Gos. testa convoluta, spira turbinata, ultimo anfractu inverse-conico; apertura angusta elongataque, basi emarginata; labro prope suturam insinuato, labio plicoso, plicis anterioribus fortioribus.

The characteristic distinction of the genus *Gosavia*, which has been proposed by me in the revision of the Gosau Gastropoda (1865, loc. cit.) for a species previously described by Zekeli as *Voluta squamosa*, consists in the plication of the inner lip. The form of the shell is quite similar to that of a *Conus*, and also the notch of the outer lip near the posterior suture, when compared, for instance, with *Conus marmoreus* and others. The spiral striation seems to be rather peculiar, although indicated in a few species of *Conus*. The folds belong to the callosity of the inner lip, and have nothing to do with the striation, so that through this development a certain transition seems to be formed from the *CONIDÆ* to the *VOLUTIDÆ*. Attaching great importance to the characteristic form of the shell of a *Conus*, we think it rather more probable that the animal of *Gosavia* was more like that of a species of this family, than of the *VOLUTIDÆ* or *PLEUROTOMIDÆ*, between both of which it seems to form a passage.

The long-known *C. tuberculatus* is most nearly related, in its ornamentation, to *Gosavia*, but no plaits have as yet been observed on the columella of this species, although there is no positive proof that they do not exist. Our Indian fossil is the second known cretaceous species of this genus, the first above referred to, *Gosav. squamosa*, having been described from the Alpine Gosau formation, which may be considered of about the same age as the cretaceous deposits of South India. Another cretaceous species which may belong to the genus is the *Mitra Limburgensis*, Binkhorst (Monog. foss. Limburg., p. 66, Pl. II, Fig. 8); but this species, as described, has plaits only in the middle of the columellar lip, with a remarkably different kind of disposition, and has apparently no notch on the outer lip.

I am not at present aware that either in European or American tertiary strata any species occur, which could justly be referred to this genus, but it seems to have been much more numerous represented in the older tertiary beds of India. It is not improbable that the existence of several species in European tertiaries also, may, after a time, be established. Any person who has given attention to this matter will have seen, that the greatest care is required in the preparation of a specimen in order not to injure the columellar plaits. It would indeed necessitate the admission of no ordinary succession of phenomena, if it were really a fact, that forms which existed during the cretaceous period both in Europe and India, should have so largely increased in number in the latter portion of the earth's surface, while they disappeared altogether from the former, although at the same time the eocene faunæ of both countries afford many very striking similarities, and not a few specific identities.

D'Archiac (Groupe Nummulitique de l'Inde, 1853) describes the following species, which I do not see how to separate from *Gosavia*, but which exhibit very remarkable differences from *Voluta*, or any other known *VOLUTINÆ*, both as to their form and the distribution of the columellar plaits over the whole extent of the inner lip, the anterior plaits being always the strongest: *Voluta dentata*, Sow. (*loc cit.* 324, Pl. 32, Fig. 2, Pl. 33, Fig. 11); *V. Haimei*, D'Archiac (p. 325, Pl. 31, Figs. 26 and 27); *V. Sismondai*, D'Arch. (326, Pl. 31, Fig. 25); *V. multi-dentata*, D'Arch. and Haime (326, Pl. 32, Fig. 1); *V. Humberti*, D'Arch. et Haime (327, Pl. 34, Fig. 9); *V. Salsensis*, D'Arch. and Haime (328, Pl. 34, Figs. 10 and 11). There may be a doubt whether the beds from which these have been obtained be truly Nummulitic. On this point I can only refer to the repeated statements of D'Archiac, that Nummulites occur with them. And if in other respects these beds contain Nummulitic fossils, i. e., are eocene, there is no reason for doubting that those shells must be of the same age. We have in our (Geological Survey) collections good specimens of *Vol. dentata*, and these are generically identical with the cretaceous *Gosavia*: of the other species, I have seen only doubtful casts of *V. multidentata*. I may, however, take this opportunity of mentioning, that I know of several strong indications of the occurrence of cretaceous deposits in the Punjab and Scinde.

The sole living representative of *Gosavia* appears to be *Imbricaria*, Schum. (*Conohelix*, Swains). Neglecting the notch on the posterior lip in the former, and its interior crenulation in the latter genus, the resemblance is indeed very marked; and as the animal of *Imbricaria* and *Cylindra* are in some respects different from other *MITRINÆ*, it may after a while be found convenient to unite these three genera into a separate group, placing them intermediately between the *CONIDÆ* and *VOLUTIDÆ*. When the teeth in any of the species of the two last mentioned genera have been recorded, it can then be easily settled whether they are better kept separate, or be added as a sub-division of the *CONIDÆ*, to which, I cannot help thinking, they seem to have more relation than to the *MITRINÆ* of the *VOLUTIDÆ*.

1. GOSAVIA INDICA, Stoliczka, Pl. VI, Figs. 3, 7, and 8.

Gos. testa conica, elongata, spira brevi, acuminata, fere tertiam partem totius altitudinis formante; anfractibus senis seu septenis, sutura impressa sejunctis, superne parum excavatis, inferne seu prope medium carinatis: carina tuberculata; superficie spiraliter striata: striis latis, prope suturam atque in carina tenuioribus, transversalibus partim interruptis, nonnunquam lamellosis; apertura angusta, recta; labro antice producto (Fig. 5. a.), postice ad carinam insinuato; labio calloso, multiplicato; plicis anterioribus fortioribus, approximatis atque obliquioribus quam posterioribus; canali ad terminationem (?) emarginato.

Height of last whorl of the largest specimen found, 45 mm. and probable total height 65 mm.

This species in many respects resembles the European *Gosavia squamosa*. The spire is elevated, consisting of six or seven volutions, the last of which measured

about two-thirds of the total height; they are separated by a deep sutural impression. The upper portion of each whorl is somewhat excavated, to which follows, under the middle, a rounded keel ornamented with 12-15 sharpened tubercles. The entire surface is covered with spiral striæ, which are above on the excavated portion and on the keel much thinner, on the last whorl broad and flattened. Where they are crossed by the lines of growth, they present a scaly laminated structure, if well preserved, otherwise the striæ appear to be granulated or at least somewhat thickened at short intervals. This kind of ornamentation is exactly the same as in *Gosavia squamosa*.

The aperture is narrow and straight. The outer lip is expanded anteriorly and deeply insinuated posteriorly on the keel; the lines of growth being bent in the same manner and the successive stages of growth producing the tubercles on the keel corresponding to the emargination. The inner lip is rather thickened, especially anteriorly, and plaited over its entire extent; the upper plaits are thin and distant, the anterior becoming however very thick and strong, and gradually more oblique, as they approach the anterior extremity, which unfortunately is not perfectly preserved in any of our specimens, but it could scarcely differ from that of *Conus*. There are generally about eight or nine plaits, the three upper ones thin, the five or six lower ones stronger. I have not been able to trace in the European *G. squamosa* more than three strong plaits, but there may be some more thinner ones. Besides this, the European species differs by having the keel ornamented with more numerous and thinner tubercles, placed nearer to the upper or posterior suture, the reverse of which is the case in the Indian.

Localities.—West of Kullygoody, near Serdamungalum, and between Andoor and Veraghoor; not uncommon.

Formation.—Trichinopoly group, but close to the boundary of the Arrialoor, with which the light coloured sandstones agree better in their mineralogical characters.

VIII. *Family*.—*VOLUTIDÆ*.

The three groups of shells, known under the generic names of *Voluta*, *Mitra*, and *Margarella*, as introduced by Lamarck, are commonly regarded as the chief representatives of this family; but there exists no little controversy on the subject of the classification of the forms, which ought to be admitted or excluded.

All the shells belonging to the three genera named above have a *certain solid structure, the surface being often totally or partially covered with a thin enamel coating as in the CYPREIDÆ; the spire is generally very short as compared with the size of the last volution; the anterior extremity is notched and occasionally produced into a short canal, and the inner lip is provided with columellar plaits in all stages of growth.*

Several families have been established, more on account of some differences which occur in the animals, than in the shells, although none of these seem to justify the necessity for such a step. The considerable difference between the animals

of *Mitra* and *Voluta* lies in the dentition; the teeth in *Mitra* being in three series, and in *Voluta* and *Marginella* in only one. I shall, however, further on notice a few points, which would appear to be more conclusive that *Mitra* ought to be classed with the *VOLUTIDÆ*, rather than with the *FASCIOLARIDÆ*, as proposed by Gray.

Viewing the large number of fossil species described under *Mitra* and *Voluta*, we may without hesitation assert, that it is impossible to carry out such a distribution into families, where often even the generic determination of species must remain doubtful. It would appear to give a sufficient exposition of these differences, if we accept four sub-families, viz., *MARGINELLINÆ*, *VOLUTINÆ*, *VOLUTOMITRINÆ* and *MITRINÆ*; and we shall therefore treat them accordingly. Deshayes recently* admitted *Voluta*, *Mitra* and *Columbella* into the family of *VOLUTIDÆ*, and strongly advocates the exclusion of *Marginella*. He criticises Dr. Gray's classificatory changes very sharply. These, however, ought rather to be duly acknowledged, as indicating a steady progress in science; for it yet remains to be seen, how many followers Deshayes will find for his own classification.

a. Sub-family, — *MARGINELLINÆ*.

The animals of *Marginella* and allied genera are no doubt closely related to those of the *CYPRÆIDÆ*, the tentacles being long, close together, bearing the eyes near their basis, or within the first half of their length, above and externally on small bulgings; the siphon is of moderate length, simple at the base; the teeth on a lingual membrane, band-like, with numerous conical dentitions (resembling in form the lateral teeth of the *CYPRÆINÆ*); foot large, expanded, truncate in front; mantle enveloping the greater part of the shell and covering the same with an enamel coating; no operculum.

The shells are usually of small size, solid, ventricose, strongly involute, and, in full grown state, occasionally even convolute; exterior surface mostly smooth; anterior extremity not produced, only notched; mouth linear, outer lip often thickened and toothed internally, inner lip always with numerous plaits in all stages of growth.

The *MARGINELLINÆ* as restricted exhibit a great variety of form, and there appears every reason why the old genus *Marginella* of Lamarck ought to be separated into several smaller divisions (some of which are very characteristic, as stated by H. and A. Adams) under *Marginella* and *Persicula*. There is, however, no inducement for us to enter here into any discussion as to the value of those so-called sub-genera. Besides the species quoted by Adams under *Marginella* and *Persicula*, we think only those of *Volvaria* and *Volvarina*, Hinds, have to be admitted within the limits of this sub-family. The genus *Volvaria* ought to be restricted, as

* Paris fossils, 1865, III, 572.

Deshayes very properly observes (vide Anim. s. vert. bas. de Paris, III, p. 541) to those species only which have the margin of the outer lip not thickened, while for those forms which have a thickened outer lip, like *Marginella* and others, but only a few anterior plaits on the columella, Hinds' name *Volvarina* could remain in use. Gray (Guide, 1857, p. 30) retains *Volvaria* in the same sense, and does not acknowledge any living representative of the genus, while Deshayes knows two living species, one of which is the *Volvaria pallida*. It cannot be questioned that, as regards the general form of the shell, the fossil genera *Acteonella*, *Volvulina*, *Cylindrites* and others show the greatest relation to *Volvaria* and *Volvarina*; there are, however, some very important reasons, which urge the classification of these fossils in the group OPISTHOBRANCHIA. We have already (page 58) referred to *Erato*, Risso, advocating the view of its belonging to the CYPRÆIDÆ. *Pachybaltron*, Gask. appears to be more successfully classed by Gray and Chepu in the family CASSIDIDÆ.

As I have already stated, Deshayes is determined, after a *repeated and minute examination* of the forms of all the MARGINELLINÆ, to class this group of shells with the CYPRÆIDÆ. Deshayes proposes this, I believe, only on the ground of the external similarity of the animals in preference to all other distinctions. Let us consider the animal first: In *Marginella* (restricted) the animal has long tentacles, and an expanded mantle, enveloping the shell as in all other CYPRÆIDÆ, but the mantle is quite as much expanded in the true VOLUTIDÆ also (as for instance in several of the species of *Melo* and *Scapha*); it is, however, always smooth on the exterior surface, and not provided with those *filamentous appendices*, which are very characteristic for by far the greatest number of the CYPRÆIDÆ. If the length of the tentacles (and they are not so very long in several other true *Marginellæ*) ought to be taken as a conclusive distinction, how is it possible for Deshayes to maintain the unity of the genus *Marginella*, and not to separate even generically *Persicula*, the animals of which are decidedly more like VOLUTINÆ than CYPRÆINÆ? Looking further to the dentition of the radula, we find no support whatever for such a transfer of *Marginella* to the CYPRÆIDÆ. The shell of *Marginella*, which has columellar plaits during all stages of growth, is by this character alone decidedly more nearly related to the VOLUTIDÆ than to the CYPRÆIDÆ, in which the dentition of the margins appears only in stages of maturity. Besides this, the outer lip in many MARGINELLINÆ has only a thickened and shelving outer edge and is not involute, as, without exception, it is in the CYPRÆIDÆ.

Not many fossil species of the *Marginellinæ* are known. They appear to have been more numerous in the cocene period than in the neogene, but none are as yet known from the cretaceous strata. The single species *Marginella involuta*, Zekeli,* from the Alpine Gosau deposits has been shown to be a *Cypræa*, or at least to belong undoubtedly to the sub-family CYPRÆINÆ.†

* Abh. Geol. Reichs Anst. Wien, 1852, I, p. 65, Pl. IX, Fig. 11.

† Sitzb. Akad. Wien, 1865, Bd. LII. Revision etc. p. 64.

b. *Sub-family*,—*VOLUTINÆ*.

We accept this sub-family in the same sense as Adams' *VOLUTIDÆ*, Gray's *VOLUTINÆ* or Chenu's *Voluta* with a large number of sub-genera; and as all the principal forms are amply illustrated and noticed in Chenu's *Manual*, it will be sufficient to refer to that publication.

Chenu enumerates sixteen sub-genera, the greater part of which, we think, ought with full reason to be admitted as equivalent to generic distinctions; it will even be necessary to increase this number, when all the known fossil species shall have been properly attended to. Further sub-divisions of the whole group, as those of *YETINÆ*, etc. Gray, or *CYMBINÆ* and *ZIDONINÆ*, Adams, may be convenient, but the characters upon which they are based seem to depend very much on local modifications of one and the same shell (as in *Cymb. proboscida*, or in *Melo ethiopica*) and must, therefore, always be of subordinate importance. The known fossil species do not give much support to these minor sub-divisions, although I have no hesitation in saying, they may be found both convenient and useful.

The animals of the *VOLUTINÆ* are all remarkably similar in form; they have a large head with short stout tentacles, distant at their basis and united by a broad veil forming a hood over the head; the eyes are usually on thickened bulgings behind the base of the tentacles; the siphon is of moderate length, usually re-curved, and with more or less developed auricles on each side of the base, sometimes partially connected with the veil. The mantle is enlarged all round, as in *Cymbium*, *Melo* and others, covering the greater portion of the outer shell-surface with enamel, similarly to what has been already noticed in the *MARGINELLINÆ*; but it does not seem to have any filamentous appendices on the exterior surface, as in the *CYPRÆIDÆ*. Sometimes it is expanded only on one, the columellar side, as in *Volutella*, D'Orb. The foot is generally of a simple triangular shape, adapted for creeping, truncate in front and prolonged posteriorly, as in the greater number of the remaining sub-families.

The teeth are on a lingual membrane in one series only. A horny operculum has been observed by Gray in the genus *Voluta*, as restricted to species like *V. musica*, and lately by Crosse in several species of *Lyria*. (Vide *Journal de Conchyliol.* 1866, 3 ser., Vol. VI, p. 105.)

The variety in form of the shells is very great, but they are so gradually connected with each other, that very great difficulty is experienced even in separating the known living species into the genera, as given in Chenu. A marked character of the shell of all *VOLUTINÆ* is the relatively *great size of the last volution, the mamillate apex, and the anterior plaits of the columellar lip being stronger than the posterior*. Only where these characters have been observed, does there seem to be full reason for referring the fossil species to this sub-family. Of the cretaceous species many belong to *Volutilithes* and *Lyria* (the same is the case with the lower tertiary species): these two genera are, however, exactly those which form a gradual passage to the *FASCIOLÆIDÆ* and the *MITRINÆ* respectively. When in some

species of *Lyria* the plaits are not well developed, or in the fossil state not exactly to be observed, there is no possibility of distinguishing those shells from others, which are attributed to *Turricula* and other genera of the *MITRINÆ*. As to *Fusciolaria* and *Volutilithes*, the more elongated and narrow canal and the greater height of the spire of the former usually serve as more easily recognized differences.

Looking to all the known cretaceous species of the *VOLUTINÆ* we venture to say, that besides *Volutilithes* and *Lyria*, which are the most numerous, several other genera appear to be represented. In spite of the greatest and most marked resemblance in the exterior form of the shells, there is very often a smaller number of columellar plaits to be observed, as compared with the recent representatives. We can scarcely think that this character, which is so very much dependent on the good preservation of the fossil, could be admitted as conclusive, although the difference ought always to be recorded. Several of the cretaceous species may form new generic types. We cannot, however, anticipate much success in an attempt to classify the known cretaceous species, in accordance with the present state of conchological science, because many of them are known only from very deficient specimens, and until this be remedied, the general term *Voluta* will often be most acceptable. At the same time we should not feel justified in reporting on such interesting material, belonging to the *VOLUTINÆ*, as we have from the South Indian cretaceous rocks, did we not avail ourselves of the opportunity of showing, that such a division into more specified and restricted genera is not only necessary, but that the existence of such distinctions can be traced even in this remote period. We shall therefore carry out this division in our special case, so far as it appears advisable.

Deshayes, as usual, very much favours the unity of a 'grand' genus *Voluta* in Lamarck's sense, although it is difficult to see with what advantage. It cannot be said to add to our detailed and specified knowledge, though no conchologist will deny, that all the numerous species described and known as *Voluta* belong to one group. The question will soon be reduced again to what authors may choose to call a genus, or a sub-family, family, or tribe. On page 583, M. Deshayes himself, after having discussed and established the unity of the genus *Voluta*, proposes five divisions or groups of this *Voluta*, and says they appear to be 'useful,' as we think no one will hesitate to admit. But if 'useful,' they must be definable by some characteristic distinction; and if this be once admitted, the desirability of a sub-division of Lamarck's genus *Voluta* is abundantly established. Only the far less important question will then remain, whether we prefer to call such groups by a fixed and definite name, or to mark them by a letter *a*, *b*, *c*, &c., and whether we carry the definition to a greater or lesser degree of strictness, for the convenience of further determinations. I believe it to be merely a matter of opinion and convenience, as to which of these systems tends most to our progress in the knowledge of different types of shells. I am of course well aware that many conchologists believe themselves fully satisfied, that the genera in our zoological and botanical literature are and must be more than groups of necessary convenience, but it will soon be very difficult for them to find much support for these views. That this—I mean mere

convenience—is actually the case with many of our so-called genera of *shells*, cannot be questioned, but it is the study of the development of organic beings, which must be the essential guide in adopting a nomenclature in accordance with the progress of natural science.

Pictet enumerates (Mat. Pal. Suisse. 3 me. ser., 2 pt., pp. 679—681) 42 cretaceous species of *Voluta* from Europe, and several from other countries. But these numbers must submit to very considerable changes. We shall note here the principal alterations which seem desirable, and some additions which have been made known since.

The first 12 species noticed by Pictet—if Gueranger's and D'Orbigny's species (in "Prodrome") be correct—will probably stand. The *Voluta elongata*, D'Orb. (see *Fulguraria* id. page 87) is not identical with *Fasciolaria elongata*, Sow., which species must provisionally remain as a *Fasciolaria*.

Voluta deperdita, Goldfuss, is probably a *Fulguraria*.

The next six species, from the German cretaceous deposits, are all more or less doubtful, but nothing can be done with them at the present. Extensive comparison and careful examination of better materials will alone enable a final disposal of these doubtful names.

The species given by Pictet as Nos. 20—35 and described by Zekeli from the Gosau deposits have been critically examined by myself,* and reduced to the following species: *Volutilithes fenestrata*, Zek.; *Voluth. acuta*, Sow. (*V. subacuta*, D'Orb., *V. Bronni*, *fimbriata* and *gibbosa*, Zek.); *Voluth. Ctsparini*, D'Orb.; *Voluth. (Fulguraria) elongata*, D'Orb.; *Voluth. coxifera* and *carinata*, Zek. The Gosau deposits, therefore, add only four new species to the number already known.

Müller reported four additional species from the cretaceous beds near Aachen (Aix la Chapelle), of which the *Vol. cingulata* and *Benedeni* are rather more like *Fasciolaria*, although they may belong to *Volutilithes* or an allied genus. *Mitra Murchisoni* of Müller, belongs probably to *Fulguraria*, and it is even very questionable if it be really different from *Ful. elongata*, D'Orb. The *Mitra pyruli-formis*, Müller, probably belongs to our new generic type, *Ficulopsis*, in which case it must be transferred to this sub-family. Careful examination would also seem to bring in a similar change with *Melongena rigida*, Müller (ibid. p. 78, Pl. 3, Fig. 22), which may belong to *Volutilithes*. Thus the number of species from Aachen may be five or six, when these proposed alterations can be better established. Binkhorst describes, in addition to the *Voluta deperdita*, Goldfuss, three new species, of which the *V. monodonta* is very much like the Gosau *V. acuta*, Sow., and may prove identical.

With these alterations we admit not more than about 32 species as at present known from the cretaceous rocks of Europe, and of these, I believe, only one is as yet known from England.

The *Voluta rigida*, Baily, from South Africa, has been identified by me with a South Indian *Fasciolaria*, but, on the other hand, three species have to be noticed from Algiers, described by Coquand.† These are *Voluta Baylei*, *algira* and *pusilla*.

* Sitzb. Akad. Wien. 1865, Bd. LII Revision, pp. 70, &c.

† Geol. et. Paleon. Constantine, 1862, pp. 182 and 183, Pl. II, Fig. 11, Pl. V, Figs. 10 and 11.

From America a large number of forms belonging to this sub-family is known. Gabb, in his catalogue,* enumerates three species of *Voluta* and ten species of *Volutilithes*. But I am afraid that all those species with "surface markings unknown," and represented in outline only (such as *V. biplicata*, *nasuta*, &c., &c.), will ever remain dead letters to any subsequent observers, unless better descriptions and figures, or rather better specimens, be supplied. In his Palæontology of California (I, p. 102) Gabb describes one species previously named by Shumard, *Volutilithes* (*Volutalithes*, p. 243) *Navarroensis*. Other American species may have been published, which I have not had an opportunity of becoming acquainted with.

The ten Indian species described by Prof. E. Forbes† have, during our recent examination, led to a totally different arrangement from that proposed by D'Orbigny. I have retained only four of E. Forbes' species in this sub-family. The *V. Trichinopolitensis* I have identified with *Fulguraria elongata*; two species, *V. septemcostata* and *cineta* of Forbes, I have not been able to identify at all, nor can I add anything to the knowledge of them. They must stand provisionally as placed by E. Forbes. *Voluta citharina* I have transferred to the sub-family MITRINÆ and *V. Camdeo* and *breviplicata* to the CANCELLARIDÆ. On the other hand, I have added to this sub-family the *Pyrula Pondicherriensis*, Forbes, under a new generic name, *Ficulopsis*, and nine other species chiefly belonging to *Lyria* and *Volutilithes*. Thus the total number of VOLUTINÆ, from the South Indian cretaceous rocks, as given in this paper, amounts to fifteen species, which will be found described under the following names: *Scapha attenuata* and *gravida*; *Melo pyriformis*; *Ficulopsis Pondicherriensis*; *Fulguraria elongata* and *multistriata*; *Volutilithes accumulata*, *latisepta*, *muricata*, *radula*; *Athleta purpuriformis* and *scrobiculata*; *Lyria granulosa*, *crassicostata* and *formosa*.

Supposing now that the determinations, as here given, are, at least with regard to the sub-family, correct—a supposition which I believe is fully admissible on this point—and allowing on the other hand for the small area, wherefrom these fossils have been obtained, we may still without much hesitation form the conclusion, that the East had already during the cretaceous period a richer fauna of VOLUTINÆ than the West, an observation which holds correct also during the present geographical distribution of the different species. The VOLUTINÆ were fast disappearing from the Western seas, and were*gradually more limited to those of the East, most probably, because the Eastern waters had preserved a higher temperature. So, for instance, the Vienna basin was inhabited during the miocene (neogene) period by several species of VOLUTINÆ, while almost every trace of them disappeared in the Mediterranean Sea. Similar observations have been made in other parts of the European seas.

I may take here the opportunity of mentioning, that several species of VOLUTINÆ are known to occur in the cretaceous deposits of the Nerbudda valley

* Proc. Am. Phil. Soc. VIII, pp. 149 and 150.

† Trans. Geo. Soc. London, 2nd. Ser. VII.

and near Cherra-Poonjee (North-East Bengal), the fossils of both of these localities awaiting examination as soon as those of the South Indian cretaceous deposits have been completed.

We have thus about 64 *species of VOLUTINÆ known from cretaceous deposits*, of which not a single one has yet been found to occur in the lowest cretaceous or Neocomian beds. It is also very remarkable that, except some doubtful casts, no species have been traced in the lowest beds of the Indian cretaceous deposits—the Ootatoor group, although several species are well known from the contemporaneous (?) beds, containing *Ammonites inflatus*, *Mantelli*, &c., in European districts. It must not be forgotten, however, that in other respects also, our Ootatoor beds have yielded only a small number of Gastropoda and Lamellibranchia, and these for the most part only in poor casts. We are thus led to expect, that this discrepancy will find its solution rather in a local geological explanation, than in any difference of time, as would be suggested by the present definition of the several groups.

The *Melo pyriformis* and *Ficulopsis Pondicherriensis* have, it is true, been found in the Pondicherry sandstones, which are usually classed in the Valudayur group, but as I have already stated, there is some discrepancy in the distinctions of the different strata of these sandstones, and among the so-called Valudayur group beds of more recent date, corresponding in age with the Arrialoor group, seem to be still included. Equally doubtful is the occurrence of *Fulguraria elongata* in the Ootatoor beds.

We shall now proceed to a more detailed description of the species, confining, however, our remarks only to those genera which are represented in the present series of our cretaceous fossils.

XIII. SCAPHA, Klein, 1753; Gray, 1857 (?)

(H. and A. Adams' Genera, II, p. 616, Appendix 1: Gray's Guide, 1857, p. 33.)

The four sub-genera distinguished by Gray in this genus can be only approximately defined, and in the determination of the fossil forms, there seems scarcely a possibility to retain them, unless our materials are very much more complete than now. From the want of the small posterior plaits on the inner lip and of an operculum, there is full reason to separate these forms from *Voluta* proper, to which they are most nearly related. The shell is usually smooth or only obsoletely sulcated spirally; the number of columellar plaits varies from three to five.

I do not know a single cretaceous species, which could with any certainty be referred to this genus; and even of the two, which we here refer to the same, only the *Sc. grävada* has strictly speaking claims to it, the form of the shell of the second species being rather unusually much elongated. But as the other characters agree, it may stand here provisionally, until fully preserved specimens settle the question. The *Volu. Requieniana*, D'Orb., presents a similarity in ornamentation, but the general form is so very different that the species, as it appears to have been based upon a rather perfect specimen, may better be retained as *Volutilithes*.

1. *SCAPHA ATTENUATA*, *Stoliczka*. Pl. VI, Figs. 4 and 5.

Scaph. testa ovate elongata; anfractibus septenis, ad suturam impressis, sublævigatis, supra medium tuberculatis: tuberculis crassis, antice in costas prolongatis, attenuatis, circiter octonis in uno circuitu; ultimo anfractu spiræ in altitudine fere equali; apertura compressa, antice effusa, in labii margine plicis ternis obliquis, conspicuis ornata; canali brevi.

Spiral angle about 35°; sutural angle 13°.

Height of last whorl: total height of shell (considered as 1.00) 0.48.

An elongated shell, composed of about seven volutions, the last of which is nearly of the same height as the spire. They are slightly convex, contracted at the posterior suture, and each of them ornamented with 8-9 strong, above the middle rather sharply tuberculated, ribbings, which on the last whorl do not extend anteriorly beyond the middle. The surface is only obsoletely spirally sulcated. The margin along the suture is occasionally thickened, and the keel below the same on the last whorl smooth, losing all the previous tuberculations (as seen in Fig. 5). The aperture is equally elongated as the shell, laterally compressed, the canal being comparatively short. On the inner lip three oblique folds have been observed, the first anterior being the strongest.

The specimen represented in Fig. 4 is, except on the apex and the extreme margin of the outer lip, quite complete. The more elongated form combined with a different shape of the whorls, and especially the rib-like tubercles, do not admit of our uniting this form at present with the *Scapha gravida*, which also differs by a larger number of folds on the columella, being four, while in the present species they do not exceed three, of which only the two anterior are stronger. The elongated form does not agree with living species of this genus, as already stated.

Locality.—Kolakonuttom, from a yellowish clayey sandstone, and east of Anapaudy; few specimens were found.

Formation.—Trichinopoly group.

2. *SCAPHA GRAVIDA*, *Stoliczka*. Pl. VI, Fig. 6.

Scaph. testa ovata, crassa, spira brevi, subacuta; anfractibus læviusculis, prope medium angulatis atque tuberculatis: tuberculis circiter 8 in uno circuitu, antice versus in costas plus minusve prolongatis, crassis; labio antice quadriplicato.

Spiral angle 65°; sutural angle 14°.

The shell of this species is somewhat thicker than that of most of the living species, but the broadly ovate form is the same. The whorls are angulated near the middle, and each provided with eight or nine strong and thick tubercles, which are prolonged anteriorly into as many short ribs. On the last whorl, which is higher than the spire, these ribs disappear gradually towards the anterior termination. The sutures are undulated according to the elevations of the ribs; the shell is otherwise perfectly smooth, save the fine striæ of growth. The inner lip exhibits four oblique folds, the first of which on the edge of the canal is the smallest and the next the

strongest. Of this species we know only the figured specimen, which, although characteristic enough, is in many respects imperfect; the termination of the anterior extremity and the outer lip not being preserved, have been restored in outline according to their probable shape.

Locality.—From a white sandy limestone near *Nimnyoor* in the Trichinopoly district.

Formation.—Arrialoor group.

XIV. MELO, *Humphrey*, 1797.

(H. and A. Adams' Genera I, p. 159; II, p. 616; Chenu's Manual, I, p. 186.)

The *ventricose form and the callose covering* are characteristic for the species attributed to this genus, in which certain sub-divisions, at least two, according to the presence or want of spines on the posterior portion of the outer lip, must be allowed to be of great convenience; it would probably be better to retain only the species with the former character under the name *Cymbium*. There are several upper and lower tertiary species, which belong to this genus, but the cretaceous species to be now described is to our knowledge the only secondary representative. It bears in every respect the characters of the genus, and is on the whole much like our *Melo indica* of the neighbouring seas, so much indeed, that this can be regarded as only an offspring of the fossil species.

1. MELO PYRIFORMIS, *Forbes*, *sp.* Pl. VI, Fig. 9.

1846. *Volula pyriformis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 130, Pl. XII, Fig. 1.

„ „ D'Orbigny, Gabb, Pictet and others.

M. testa pyriformi, spira brevissima, late conica, callositate plus minusve tecta; anfractibus quinis, fere planis, sutura impressa sejunctis, primis mamillatis; ultimo inflato, antice valde prolongato, attenuato; superficie polita, lævissima; apertura elongata, postice acuta, antice effusa; columella callosa, quadriplicata: plicis antice versus obliquioribus atque fortioribus.

Spiral angle 90°—100°; sutural angle 5°—8°.

Height of last whorl: total height (taken as 100) 0·80—0·90.

This fine species approaches, as already stated, very closely to *Melo indica*, Gmel., one of the typical forms of this genus. The embryonal whorls are somewhat enlarged, resembling a mere globule; the others are nearly plane, and impressed along the suture, somewhat contracted about the middle; the last whorl envelopes the greatest portion of the previous, leaving a very short broadly conical spire visible. Usually there are only about five volutions present. The shell is very thick throughout, but especially along the suture, where it reaches high up on the preceding volution. In a perfect and probably full grown state, it was covered with an enamel coating, giving thus to the surface a smooth and polished aspect, in which case the sutures are marked with only obsoletely impressed lines. When this coating is removed, the fine striæ of growth and also the sutures become clearly visible.

The callose inner lip exhibits four plaits, which become gradually more oblique and at the same time stronger towards the anterior emargination of the aperture. The first fold next to the canal is the least visible on the aperture, although it is the strongest more internally. The margin of the outer lip is somewhat enlarged, and, so far as can be seen from some fragments, sharpened from inside.

The largest specimen from Pondicherry is in the Madras collection: it measures 95 mm. in height and 65 mm. in width on the last volution.

Localities.—West of Kullygoody and Pondicherry; not common.

Formation.—Trichinopoly and (?) Valudayur groups.

XV. FICULOPSIS, *Stoliczka*, 1867.

Ficulop. testa pyriformi, antice attenuata, postice inflata; spira brevissima; superficie spiraliter atque transversim striata vel costulata; columella crassa, extus atque antice angulata, intus applanata, plicata.

Under the above name, I propose to class the Indian species described and figured by Forbes as *Pyrula Pondicherriensis* and figured by D'Orbigny as *Pyrula carolina*. The shell exteriorly in form and appearance does not differ from typical species of *Ficula* as restricted (*Pyrula* or *Sycotypus*) being reticulated on its surface and having a very short spire. While, however, the columellar margin in *Ficula* is very thin, it is in *Ficulopsis* very thick, externally angulated, internally flattened and provided with a number of plaits, of which the anterior are the stronger. This sufficiently justifies the placing of the genus among the *VOLUTINÆ*. In this respect *Ficulopsis* may be said to combine the characters of *Melo* and *Fulguraria*, agreeing with the former in general form and with the latter in its ornamentation, and especially in the characteristic flattening of the anterior and inner portion of the columella.

The aperture is very long and of the same shape as the shell; anteriorly it is gradually narrowed, and at its termination no doubt emarginate (our specimens are not quite perfect at this point). It is difficult to say whether the *posterior notch of the outer lip*, which exists in the species now described, ought to be included in the generic characters or not; it would probably be better not to do it at present, until some other such characteristic forms have been made known.

I am not aware of any fossil species, which could be fairly attributed to this genus, unless the *Mitra pyruliformis*, described by Müller (Petref. der Aachner Kreide-formation, II, 1851, p. 23, Pl. 3, Fig. 25) from the cretaceous deposits near Aachen, belongs to it, which does not appear unlikely.

1. *FIGULOPSIS PONDICHERRIENSIS*, Forbes, sp. Pl. VI, Figs. 10 and 11.1846. *Pyrula Pondicherriensis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 127, Pl. XII, Fig. 19.1847. *Pyrula Carolina*, D'Orbigny, Voy. Astrolabe et Zélée, Pal. Pl. II, Figs. 34 and 35.1850. " " D'Orbigny, *et auctorum*.

Fio. testa elongate pyriformi, spira brevissima, mucronata; ultimo anfractu postice inflato, antice prolongato atque sensim attenuato; superficie costulis spiralibus atque transversalibus fenestrata, costulis ultimis tenuioribus atque in speciminibus adultis nonnunquam subobsoletis; apertura perlonga, postice emarginata, antice late effusa; labro ad suturam insinuato, antice paululum expanso, intus sulcato; labio calloso, quinque-plicato, antice crassissimo, ad marginem exteriorem angulato, intus applanato.

Spiral angle 110°.

Height of last whorl : total height (considered as 1·00) ... 0·91

As regard the peculiar form of this species and its relation to others, we have already, in the remarks on the genus, noticed all that was needed. The five oblique folds are very distinctly visible, and it is even not impossible that there may be more of them. They disappear on the margin of the aperture totally, which misled Forbes and D'Orbigny to describe the species under *Pyrula*. The anterior portion of the inner lip is very much angulated exteriorly and strongly thickened; the folds terminate over nearly its entire extent, as may be seen from the Fig. 10, Pl. VI.

The transversal ribs are in young specimens of nearly equal strength with the spiral, forming on the place where they meet slight tuberculations and dividing the surface in regularly squarish lacunæ. In more largely grown specimens the spiral ribs much predominate on the last whorl, occasionally alternating with secondary ribs. Besides these ribs there are striæ of growth distinctly visible, being along the suture deeply insinuated and causing a similar emargination on the margin of the outer lip. There are four volutions visible on the figured specimen from Pondicherry, but the uppermost are devoid of the shell surface, for which reason it cannot be ascertained, whether the apex was mammillated or not, but if it was, as seems probable, it could have been only slightly so, as compared with other *VOLUTINÆ*.

Localities.—Pondicherry and W. of Kullygoody in Trichinopoly; at the former locality the species appears not to be rare; at the latter only a single fragmentary specimen has been as yet procured.

Formations.—Valudayur- and Trichinopoly- groups.

XVI. *FULGURARIA*, Schumacher, 1817.

(Vide Adams' Genera I, p. 165.)

The principal characteristics of this genus lie in the *elongated form, spiral striation, numerous plaits about the middle on the inner lip, much produced anterior extremity with the columellar lip sharpened exteriorly and more or less flattened interiorly.*

There are only three species known living, and for the *Fulg. dubia* H. and A. Adams propose the sub-genus *Aurinia*, although there seems to be scarcely a necessity for this, when the number and form of the columellar plaits actually varies in one and the same species, as appears to be the case.

The two species which we describe here under *Fulguraria* do not differ as regard form and ornamentation in any way from *Fulg. fulgura*, and they are both distinguished by the sharpened anterior margin of the inner lip. In the living species, the inner lateral flattening and the central thickening of the inner lip is by no means so clearly developed, but it is distinctly indicated, and its form in the fossil species can be compared only with that of the living *Fulguraria*.

One of the species here described, the *Fulg. elongata*, D'Orb., has only three nearly equally strong columellar plaits, and the other, *Fulg. multistriata*, n. sp., has four, three of which are stronger and the last posterior less oblique. This—the number of columellar plaits—can hardly be said to be a generic difference between the fossil and living species. I have for that purpose compared numerous specimens of the living *Fulg. fulgura*, and I find that there is a good deal of variation to be found in the form and number of plaits, although I never found them to be less than five. Some specimens have distinctly three principal folds; out of eight the two anterior, one between the first and second principal, and two behind the third being considerably thinner; sometimes there are three smaller posterior and one between the second and third principal, so as to raise the number of columellar plaits to nine or ten. Other specimens have the two first anterior small, the third is the strongest and more distant from the others, which amount to from two to five, becoming gradually thinner towards the anterior termination. Considering these changes of the plaits on one side and the great similarity of the entire shell on the other, I believe that the fossil forms ought not to be generically separated, for they must be regarded as the true cretaceous representatives of *Fulguraria*.

Another point, which may be thought of great importance, is the thickening of the posterior margin of the outer lip, its partial insinuation and a corresponding curve of all the striæ of growth below the suture. On account of this character the *Fulg. elongata* has been determined by Römer and others as *Pleurotoma*, and in some respects it recalls *Borsonia*. The insinuations of the striæ of growth may be, however, readily observed in the living *Fulguraria fulgura* too, and they are inseparably connected with the posterior constriction of the whorls; the difference consisting merely in the striæ being only a little more strongly developed near and at the margin of the aperture in large specimens of *Fulg. elongata*, than they usually are in *Fulg. fulgura*.

There are only very few tertiary species, which appear to belong to *Fulguraria*, but a good many of the cretaceous forms may be attributed to this genus, although they certainly require first a careful comparison as to their characteristic affinities with *Fulguraria*. We may mention *Mitra Murchisoni*, Müller. (Petref. Aachner Kreidef. 1851, II, Pl. III, Fig. 23), if it be really different from the *Fulg. elongata*, D'Orb., about which serious doubt must be entertained; *Volut. Navarroensis*, Shumard (Gabb,

Pal. Calif. 1864, I. Pl. 19, Fig. 56), also a similar species to *Fulg. elongata*, but apparently with the transverse ribs very slightly marked, and the whorls posteriorly less constricted; *Voluta deperdita*, Sow. (Binkhorst, Monograph Gast. et Ceph. Limbourg, 1861, Pl. II, Fig. 7 and Pl. 5^{a2}, Fig. 1); *Volutil. Eufaulensis*, Conrad, (Jour. Acad. nat. sc. Phil. 2 Ser. IV, p. 286, Pl. 47, Fig. 18) and others.

1.—FULGURARIA ELONGATA, D'Orbigny, sp. Pl. VII, Figs. 1—9.

1843. *Voluta elongata*, D'Orbigny, Pal. Franç. Crét. II. p. 323, t 220, Fig. 3.

(non *Fasciolaria elongata*, Sow.

1846. „ *Trichinopolitensis*, Forbes, Trans. Geol. Soc. Lond. VII 133, Pl. 15, Fig. 5.

1865. *Volutilithes elongata*, D'Orb. sp.; Stoliczka, Sitzb. Akad. Wien, LII Revision etc. p. 74, with references to previous authors.

Fulg. testa fusiformi, elongata, spira plus minusve extensa; ultimo anfractu maximo, postice subinflato, antice valde attenuato; anfractibus omnibus ad suturam valde constrictis, infra contractionem angulatis atque infra transversim costatis; costis 12-15 in uno circuitu, ad angulum plus minusve elevatis seu subtuberculatis, singulis in medio ultimi anfractus atque omnibus prope aperituram evanescentibus; superficie spiraliter crasse-striata; striis elevatis acutis, æquidistantibus, ad suturam nonnunquam plus numerosis atque tenuioribus; apertura longissima, postice subeffusa; labro postice ad marginem calloso, parum insinuato, ad medium atque antice subacuto undulateque marginato; labio calloso, ad medium triplicato, extus in margine columellari valde angulato, intus lateraliter plano, ibidem atque postice levissimo.

In my revision of the Gastropoda of the Gosau-formation, quoted above, I have given a list of synonyms of all the forms which have most probably to be referred to this species. I have added here the *V. Trichinopolitensis* of Forbes; as, although with some doubt, I can scarcely think that Prof. Forbes could have had another fragment before him. Among all the fossils of our very extensive collection from the Trichinopoly district, there is none other to which it could be referred, and I have figured purposely similar specimens on Pl. VII, Figs. 5 and 6, which are evidently very like Forbes' representation, save in the size.

The above description refers to the numerous specimens in general, but there are several very marked variations to be recorded. We figure the principal of these, and although it would appear that there could be no great difficulty in distinguishing at least three distinct species, we are fully convinced that it is impossible to do so, except by ignoring all the intermediate forms. We have compared several hundred specimens from the Trichinopoly district, and all of them agree in the specified characteristics. The spiral striæ, being usually on the last whorl all of equal strength and distant from each other about twice their thickness, are very characteristic. Occasionally they become obsolete in large specimens, except on the anterior portion of the last whorl (see Fig. 5), or in other more inflated specimens they alternate with somewhat thinner ones (see Fig. 7). The striæ of growth are occasionally more strongly marked and partially intersect the spiral striæ. On the

contracted portion of the whorls next the suture they are always distinct, often laminated and bent inwards, according to the thickened margin of the respective portions of the outer lip. On this same portion of the whorls, the spiral striæ are occasionally more numerous and finer; sometimes there are only three of them, equally distinct, or even two only close together near the suture; rarely they are wanting entirely. All these variations are not at all connected with the form of the shell, but they depend very often upon the state of preservation, or on the age and on the strength of the striæ of growth.

On larger grown specimens the posterior portions of the outer lip remain so strongly marked, that they cause every other ornamentation to become obliterated (see Figs. 4, 9a.). The anterior portion of the outer lip is sharpened, and according to the elevation of the exterior striæ undulating on its margin and internally sulcated. The inner lip is thickened, and its callosity often extends over the entire fore-part of the last whorl. There are, without exception, so far as has been observed, only three oblique folds present, and the interior portion of the columella is very much flattened, flanking the side of the aperture nearly perpendicularly and bearing the folds so far internally, that there is barely a trace of them perceptible in the apertural space on the perfect shell. The embryonal whorls are smooth, but not so markedly enlarged and papillose as usually in the *ROLUTINÆ* or in the recent *Fulguraria*.

We come now to the variations in form, and in this point of view we are able to distinguish three principal varieties.

Var. a.—The spire is short with an angle of from 55—80 degrees, the posterior portion of the whorls along the suture is concave, the angle below sharp, tuberculated in young specimens in consequence of the elevated terminations of the transverse ribs, (see Figs. 8 and 9), the tubercles disappearing perfectly in full grown specimens and being replaced by a smooth keel (*vide* Fig. 5). This is a very common variety throughout the upper beds of the South Indian cretaceous deposits. Römer's first published figure of this species refers to this variety. (*Vide* Pl. VII, Figs. 4, 5, 7, 8, 9.)

Var. b.—The entire shell is slender, the spire produced, the striæ on the contracted portion of the whorls usually 5-6, and on the last whorl distant transverse ribs sharpened on the keel in young, and indistinctly tuberculated on larger grown, specimens. D'Orbigny's and Zekeli's figures refer to this variety. (*Vide* Pl. VII, Figs. 1 and 2). The *Mitra Murchisoni* of Müller could also belong to this variety.

Var. c.—Shell very much elongated with numerous fine spiral striæ on the contracted portion of the whorls, the other striæ on the last whorl from the first not very thick and usually soon becoming more or less obsolete in more largely grown specimens. Keel more distinct in elder specimens than in smaller, the transverse ribs less except on the keel itself, where they form pointed tuberculations. (*Vide* Pl. VII, Figs. 3, 6.)

Each of these varieties, although not strictly confined to certain localities, may be said to prevail at one or the other. The *Var. a.* is most common at E. of Alundanapuram, W. of Kullgoody and E. of Anapaudy; the *Var. b.* near Koloture and Veraghoor; and the *Var. c.* near Serdamungalum. The species is in general very common throughout the Trichinopoly district, and there are several small specimens of

it in the Madras Museum marked with a new specific name, apparently in Mr. Kaye's or Cunliffe's handwriting. These seem to have been procured subsequently to Prof. Forbes' examination of the fossils, and are probably not from Pondicherry, but from the blueish sandstones near Garudamungalum or Serdamungalum.

Localities.—The above-mentioned are the principal localities within the Trichinopoly group, where it occurs nearly exclusively. There are only a few specimens from South-West of Shutanure, which locality lies, according to Mr. Blanford's map, within the Ootatoor group, but close to the boundary of the Trichinopoly; a few specimens are from the east of Veraghoor and south of Arrialoor out of the Arrialoor group.

Formations.—Principal position in the Trichinopoly-, doubtful in the Ootatoor-, but more common in the Arrialoor-groups.

This species is well known in Europe from the middle cretaceous deposits. It occurs throughout Northern Germany from Eastern Galizia towards Aachen and the Rhine, and is common in the deposits of the Alpine Gosau-formation. D'Orbigny described his specimens from Uchaux, and in his "Prodrome" he places it in the *étage Turonien*. It has not, so far as I am aware, been noticed in England, but a similar species is known to be very common in North America.

2. FULGURARIA MULTISTRIATA, *Stoliczka*. Pl. VIII, Figs. 1—3.

Fulg. testa fusiformi elongata, anfractibus postice prope suturam constrictis, excavatis, infra constrictionem angulatis; ultimo maximo, subventricosos; omnium transversim tuberculato-costatis, costis ad angulum terminantibus, in ultimo ad medium evanescentibus, spiraliter striatis, striis numerosis,—imprimis postice,—prope suturam nonnullis crassioribus; labio calloso, ad medium quadruplicato, plicis anticis crassioribus, obliquioribus atque magis distantibus.

Spiral angle 50°.

This species is proposed for a series of specimens, which in general form agree with the preceding *Fulguraria elongata*, D'Orb. They differ by a larger number of spiral striæ, these being thinner and placed closer to each other, and by having four columellar plaits, instead of three. The anterior of the four is somewhat more distant than the other three among themselves, and is the most oblique. Interiorly all the plaits are comparatively much more oblique than in *Fulg. elongata*, and there is occasionally a thin fifth fold next to the last posterior. The columella is equally flattened internally, but externally apparently not so much angulated, except close to the anterior extremity.

Locality.—E. of Anapaudy; apparently not very common.

Formation.—Trichinopoly-, close to the boundary of the Arrialoor-group.

XVII. *ATHLETA*, Conrad, 1860.

(Vide Jour. Acad. Nat. Sc. Phil. 2d. ser. Vol. IV, p. 292, Pl. 46, Fig. 32.)

Conrad gave the above name to a very characteristic fossil, meaning it as a sub-genus of *Volutilithes*, from which, however, the species figured by him differs essentially in having the anterior extremity little produced, scarcely half as much as in the typical *Volutilithes*, the anterior termination being moreover truncate as in *Scapha* or *Voluta*. Gabb (Proc. Am. Phil. Soc. VIII, 1861, p. 150) quotes the species as *Volutilithes leioderma*, Con., without referring to the sub-generic distinction at all. We cannot pronounce any opinion upon the American fossil, but the character noticed by Conrad seems to be not so unimportant. Conrad says, loc. cit. "labrum slightly notched or sinuous at the superior extremity," and further "the suture covered by a deposit as in the genus *Ancilla*." These differences are very marked in two of our cretaceous species. Both margins are united by a callus, producing on the aperture a distinct posterior canal, the end of which is often prolonged in a furrow below the suture, which itself is covered by the callosity of the inner lip. One of the species, the *Vol. purpuriformis*, of Forbes (*Fusus id.* D'Orbigny and others), resembles very much recent species, which are referred by Adams to *Harpula* (remarkably distinct from *Voluta*, (*sensu restricto*) and the other bears much resemblance to *Enata*, Adams (which ought to be kept distinct from *Lyria* proper, not regarded as a sub-genus only, according to Gray). I am rather sorry that I have none of these living shells to compare with our fossils, but so far as their characteristics or those of other sub-divisions of the *FOLUTINÆ* have been noticed, they seem not to exhibit these peculiarities, and I should think that if they existed, they could not have been overlooked.

The distinction from *Volutilithes* must certainly be recorded, and it remains only doubtful whether the species can be classed with *Harpula*, Swainson, or in a separate genus.

The character, as deduced from the three cretaceous species known up to the present, may be put thus :

Athl. testa ovate-conica, elongata, spira brevi; ultimo anfractu ventricosus, antice paulum prolongato, truncato atque emarginato; apertura ovali, antice late- postice anguste-effusa, marginibus postice callosis, unitis; callositate suturam tegente; labio antice plicato, postice lævissimo, plicis anterioribus fortioribus, numerosis.

Conrad mentions in *Ath. leioderma* four columellar plaits; one of our species has three and the other five plaits, although there may possibly be found to be one more in each of the two species. The same author refers to *Athleta* the *Voluta Tuomeyi* (ibid Pl. 47, Fig. 35), which belongs to the same group as *Volut. rarispina*, Lam. and others, and which, I rather believe, ought to be classed in a separate genus.

1. *ATHLETA PURPURIFORMIS*, Forbes, sp.* Pl. VIII, Figs. 4, 5, 6, 7.1846. *Voluta purpuriformis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 130, Pl. 12, Fig. 2.1847. *Fusus ponderosus*, D'Orbigny, Voy. Astrolabe et Zélée, Pal. Pl. 2, Fig. 33.* 1850. *Fusus* " D'Orbigny, Prod. II, p. 229; idem Gabb, Pictet, and others.

Athl. testa ovata; spira brevi, acuminata, apice papillari; anfractibus 5—7, ad suturam impressis, plus minusve contractis seu lente excavatis, ultimo ventricosus; superficie spiraliter sulcosa, sulcis in ultimo anfractu seniorum speciminum subobsoletis; apertura ovata, postice acuta, subcanaliculata, antice emarginata; canali recto, ad terminationem margine paulum reflexo; plicis columellaribus quinque, anticis maximis.

Spiral angle 75° — 85° ; sutural angle 9° .

Height of last whorl : total height of shell (taken as 1·00) ... 0·73—0·80.

Shell elongated ovate, with a pointed spire, consisting usually of six volutions, the uppermost of which are smooth, mamillated, and the succeeding always more or less contracted and consequently excavated along the suture. The last whorl is ventricose, especially in adult specimens, embracing more than two-thirds of the previous whorls and leaving only a comparatively short spire visible. The young shell is all over spirally sulcated, the sulci being all of equal width, except a few near the suture, where they are placed closer to each other. With advancing age the shell becomes more or less covered with an enamel coating, the sulci become broader than the elevated interspaces between them, and gradually disappear totally on the median portion of the whorls.

The aperture is enlarged ovate; the outer lip gradually becomes thinner towards the margin; the inner lip is posteriorly considerably thickened, especially where it unites with the outer lip, forming a slight canal. This callosity, arising from the united margins of the outer and inner lips, covers the lower portions of all the preceding whorls. On perfect specimens only the three anterior folds are slightly perceptible, but a little farther internally I have traced two more, and it is possible that one or two may still be shown to exist in full grown specimens. The anterior folds are the strongest, as in all other *VOLUTINÆ*. The canal is pretty long, and although it has not been observed quite perfect, there cannot be a question, that its margin has been somewhat reflexed upwards, and deeply emarginated, in which point this species appears to resemble rather more some of the *CASSIDIDÆ* than of the *VOLUTINÆ*. D'Orbigny has been certainly misled in placing the species under *Fusus*, because Forbes has neither mentioned nor figured any columellar plaits. D'Orbigny's *Fusus ponderosus*, figured in the Paléontologie of the Astrolabe, can certainly apply only to the same species.

Localities.—Pondicherry; neighbourhood of Kullygoody and between Andoor and Veraghoor; common, but very rare in good preservation. The shell of the specimens from Kullygoody is often covered all over with small round holes, produced by some kind of shell-boring Amorphozoa.

Formation.—(?) Valudayur- and Trichinopoly-groups.

2.—*ATHLETA SCROBICULATA*, *Stoliczka*. Pl. VIII, Fig. 8.

Ath. testa ovata, crassa, spira brevi; anfractibus quinis, prope planis, in medio parum excavatis, sutura impressa canaliculata sejunctis; ultimo anfractu ventricosus; superficie costis spiralibus atque transversalibus fenestrata; scrobiculata; apertura ovate-elongata, postice acute effusa, antice emarginata; labro ad terminationem posteriorem crasse dentato; labio calloso, partem inferiorem ultimi anfractus fere totam tegente, antice triplicato.

Spiral angle 82°; sutural angle 5°.

Height of last whorl : total height (considered as 1.00) ... 0.70.

The shell is composed of only five volutions, the last of which is ventricose, and enveloping the previous one to a great extent. The surface exhibits broad transverse and spiral ribs giving it a coarsely reticulated structure. Below the first sutural rib and the next stronger, there is on the last whorl a large interspace left, which having in the middle only one or two much finer ribs, forms a kind of a broad and shallow sulcus, remaining distinctly marked on all the previous whorls, where only the two ribs bounding the excavation on either side are present. Of the convexity of the last whorl nothing is seen on the upper volutions.

The sutures are deeply impressed, canaliculated. The outer lip is somewhat sharpened on the margin, and is on its posterior termination strongly thickened tooth-like. The inner lip covers the greater part of lower or front portion of the last whorl. Both margins are on the posterior canal united by callosity, and the canal itself remains visible on the entire last whorl, forming a similar narrow impression parallel to the suture and gradually uniting with the latter. There are only three oblique and nearly equal folds visible in our specimen, otherwise the species resembles much *Vol. cassidula*, Reeve (Monog. Volutidæ, 1851, Pl. XXII, Fig. 60) Japan seas.

Locality.—W. of Kullygoody in Trichinopoly; the single as yet known and figured specimen occurred in a soft whitish sandstone.

Formation.—Trichinopoly group. (?)

XVIII. VOLUTILITHES, *Swainson*, 1831.

(*Vide* Adams' Genera I, p. 167; Chenu's Manual I, p. 190, and others.)

It is well known that a large number of fossil tertiary and cretaceous species belongs to this genus, of which a single recent species has been found at a great depth near the Cape of Good Hope. The most striking difference of this genus from other *VOLUTINÆ* is the prolongation of the anterior extremity of the shell into a canal, being notched at its termination as in other *VOLUTINÆ*. In form, it must be granted, the *Volutilithes* are most nearly related to *Fulguraria*, and strictly speaking only the peculiar form of the inner lip in the latter remains as a characteristic distinction from the former. It was originally intended to establish the new genus only for the recent species and those fossil forms which agree with it in the granular or spinulose and reticulated markings of the shell surface. The palæontologists soon availed

themselves, however, of the opportunity of the new generic distinction, regarding the ornamentation as unimportant and admitting only special reference to the characteristic form of the shell. This is in many cases quite correct, but it is well known, that the kind of ornamentation often carries with it such changes in the character of the shell and thus anticipates the existence of organs, which are often recorded as generic distinctions. There are at least 35 cretaceous species known, which belong to this genus, and the number of tertiary is still larger. It will soon be necessary, if those species come to be properly classified, to direct attention to these and similar distinctions, and to group them in a way similar to what has been already done with the genus *Voluta* itself.

The number of columellar plaits varies in the fossil species usually between two and three, the latter being the most common, but the finer plaits seem to be often obliterate in a fossil state. The gradual and moderate prolongation of the anterior extremity and the shortness of the spire are often the only exterior distinctions which can be noticed between *Volutilithes* and *Fasciolaria*.

1. *VOLUTILITHES LATISEPTA*, *Stoliczka*. Pl. IX, Figs. 1 and 2.

Vol. testa ovate elongata, spira brevi; anfractibus quinis seu senis, primis lævigatis, ultimo maximo, subinflato, omninis transversim costatis; costis tenuis, 8—10 in uno circuitu, parum obliquis, ad suturam fere obsoletis, supra medium maxime elevatis, orassioribus atque non-punquam subtuberculatis, antice in ultimo anfractu obsoletis; superficie striis tenuissimis spiralibus tecta; columella tres plicas per-obliquas, tenues exhibente.

Spiral angle 44° — 46° ; sutural angle 12° — 13° .

This shell in many respects recalls *V. Casparini*, D'Orb., from the European cretaceous deposits (vide Pal. Franç. Pl. 220, Fig. 5, and Sitzungsber. Akad. Wien, 1865, Vol. LII, Revision etc. p. 72) differing from it by a generally smaller number of transverse ribs, shorter spire, but comparatively higher and less numerous whorls, and by having the three columellar folds much more obliquely placed. The embryonal whorls are somewhat enlarged, thickened, convex and smooth. The shell surface, when well preserved, exhibits on the other whorls very close and fine spiral striæ crossed by as many lines of growth, assuming on this account an irregular undulating course. The margin of the outer lip is thickened and smooth; the aperture posteriorly pointed; the inner lip thin. The ribs on the upper whorls are somewhat more numerous than on the last. It is possible that Prof. Forbes meant this species under his *Vol. septemcostata* (l. cit. p. 131, Pl. 12, Fig. 3), but nothing approximately certain can be made out of his figure or description, although this is the only way in which I can offer any signification for the species referred to.

Locality.—N. and S. of Cumalypooram, S. W. of Arrialoor, in Trichinopoly district; does not appear to be a common shell.

Formation.—Arrialoor group.

2. VOLUTILITHES ACCUMULATA, *Stoliczka*. Pl. IX, Figs. 3 and 4.

V. testa ovate-elongata, spira brevi, quartam partem totius altitudinis formante; anfractibus senis seu septenis, accumulatis: primis duobus teretibus lævigatis, ultimo supra inflato, antice valde attenuato, omninis convexis, transversim costatis, spiraliter minute striatis; costis 16—18 in uno circuitu, ad suturas subangulatis; columellæ ad medium triplicata: plicis obliquis, mediana crassissima.

Spiral angle 60°—75°; sutural angle about 10°.

The short spire, consisting of about five whorls only, these being strongly convex, the thickness of the posterior and the attenuated prolongation of the anterior portion of the last whorl, farther the numerous transverse ribs, varying from 16 to 18, and the three oblique columellar plaits, of which the middle is the strongest, can serve as the principal distinctions of this species from *Vol. Casparini*, D'Orb. and *Vol. latisepta*, n. sp.

The embryonal whorls are as usual equally smooth, but they are not so high and are much more strongly convex than in *V. latisepta*; the posterior portion of the inner lip appears to be also thicker in the present species. The surface is finely striated spirally and the striæ become coarser with the size of the shell, or rather the impressed lines become more distant and somewhat deeper. The ribs on the upper whorls, next to the smooth embryonal ones, are more numerous, thin and more oblique, while the following are straight or even somewhat bent in the opposite direction (to the right); on the last whorl they are slightly flexuous and disappear soon below the middle of the height.

I am not convinced that this species is not identical with *Vol. d'Orbignyana*, Müller (Petref. Aachner Kreide-form. 1851, II, p. 40, Pl. 5, Fig. 27); in all respects it is most nearly related to it, and differs only by a shorter spire and greater number of columellar plaits. Müller says, that his specimen is "perfectly preserved," and with two columellar plaits only, while our specimens have distinctly three plaits, if the number may not be found to be increased by a fourth posterior one.

Localities.—Near Olapady, Andoor, E. of Anapady, and S. of Serdamungalum; although not rare, no specimen has yet been found perfect with the outer lip.

Formation.—Trichinopoly group.

3. VOLUTILITHES MURICATA, *Forbes*, sp. Pl. IX, Fig. 5.

1846. *Voluta muricata*, Forbes, Trans. Geol. Soc. Lond. VII, p. 131, Pl. XII, Fig. 4.

1850. „ *submuricata*, D'Orb., Prod. II, p. 226; idem Gabb, etc.

Vol. testa ovata, antice attenuata, postice apice acuta, inflata, spira brevi; anfractibus paucis, transversim atque spiraliter costulatis; costulis primis fortioribus, in ultimo anfractu antice evanescentibus; ultimis acutis, supernis crassioribus, duabus prope suturam sulcis latioribus sejunctis, solum in anfractibus superioribus conspicuis; apertura angusta; labio ad medium 4-5 plicato, plicis anterioribus fortioribus.

This species has a remarkably short spire with an angle of about 90 degrees, and the last whorl, which becomes anteriorly gradually thinner, measures nearly

three-fourths of the total height. There are about 14 transverse ribs on the last whorl crossed by numerous spiral ribbings, which have posteriorly a sharper margin, so as to follow each other like scales. The two uppermost spiral ribs are stronger and separated from each other and from the lower ones by broader sulcations; the suture presents a tuberculated margin, swollen up and mostly obliterating the prolongations of the transverse ribs; the two spiral ribs are the only ones visible on the upper whorls, where they besides exhibit very fine spiral striæ. The inner lip exposes four or five not very oblique folds, of which the second anterior is the strongest.

Locality.—W. of Kullygoody in whitish soft sandstone; apparently a very rare shell. Forbes described his specimen from Pondicherry, but whether from the Arrialoore or from the Valudayur beds remains to be proved.

Formation.—Trichinopoly group (?).

4. VOLUTILITHES RADULA, Sowerby, sp. Pl. IX, Fig. 6.

1846. *Voluta radula*, Sow. Forbes, Trans. Geol. Soc. Lond. VII, p. 133, Pl. 12, Fig. 9.

idem D'Orbigny, Gabb, Pictet, and others.

Vol. testa elongate-ovata, spira brevi; vix tertiam partem totius altitudinis formante, anfractibus fere planis, ultimo ventricoso, maximo; superficie costulis (18-22) transversalibus atque sulcis spiralibus fenestrata, anterioribus plus minusve granulosis seu spinulosis; apertura elongata, lateraliter compressa, postice acute angulata, antice late effusa; labro ad marginem undulato; labio tenui, antice ad marginem duabus plicis obliquis ornato; canali longo, supra paulum recurvo.

Spiral angle 60°; sutural angle 10°.

Height of last whorl : total height of shell (considered as 1·00) ... 0·73

Shell elongated, ovate, consisting of about six nearly plane volutions, of which the last is somewhat ventricose, occupying a little more than two-thirds of the total height. The surface is more or less distinctly granulated. This ornamentation arises, as in other similar species, from the undulating margin of the outer lip, which is somewhat produced and bent outwards. This raised margin is, as the growth of the shell proceeds, retained and forms on the surface transversal tuberculated ribs. It depends then very much upon the state of preservation, whether the transversal or spiral sulci are more or less obliterate, and according to these the tuberculated elevations form more or less distinct transversal or spiral ribbings. When the tubercles are worn off, the surface appears regularly cancellated. In this state the present species is very like the *Vol. nitidula*, Müller (Petref. Aach. Kreideform. 1851 II, p. 41, Pl. 5, Fig. 25), from the cretaceous deposits of Aachen and it is very doubtful, whether this is different at all, as it has only two columellar plaits, like in the Indian form under description. On the upper volutions there remain generally not more than four or five spiral rows of the tubercles exposed, and the uppermost is usually separated from the others by a deeper sulcation. The transverse ribs are on the first three or four volutions slightly developed, while the spiral granulated

striae appear more strongly marked. The aperture is narrow, pointed posteriorly and broadly emarginated anteriorly; the canal is rather long and bent to the left side (in front view) and somewhat upwards. The inner lip exposes on the margin two oblique plaits only, posteriorly it seems to be so thin that the granular structure of the underlying surface appears quite distinct, although some smaller posterior plaits were probably present. It is even possible that a third thinner plait exists between the two stronger ones. The peculiar bending of the canal leaves the determination of this species as a *Volutilithes* uncertain. There are several species (*V. lima* and *limopsis*) in Europe and North America, which in form and structure of the shell exhibit scarcely any difference from this. Of cretaceous it will be necessary to compare with our Indian fossil well preserved specimens of *V. fenestrata*, Zek. from the Alpine Gosau-formation (vide Abhandlg. der geol. Reichs-Anstalt, Wien, I, p. 78, f. 13, Fig. 6, and Sitzungs. Akad. Wien. Vol. LII. Revision &c. p. 71).

Locality.—From a blueish and white sandstone near Kullygoody in Trichinopoly district several specimens have been obtained. Forbes states the loc. Pondicherry and notes it as apparently abundant. One specimen from the Madras Museum marked with the same locality agrees in mineralogical character fully with the Kullygoody sandstone. It is probable, however, that the Kullygoody beds are represented near Pondicherry, classed by Blanford in the uppermost group, and that these beds have to be referred rather to the Arrialoor than to the Trichinopoly-group, if on other grounds the distinction between those two groups is either possible and necessary. •

Formation.—Trichinopoly group, (?)—according to Mr. Blanford's map.

XIX. LYRIA, Gray, 1847.

(Vide Adams' Genera I, p. 166, II, p. 616; Chenu's Manual I, p. 190; Crosse in Journal de ser. 3, Vol. VI., p. 105)

The genus *Lyria* was first established by Gray for those *Mitra*-like *Voluta* which have a large number of columellar plaits, the two anterior of these being the strongest, and the posterior portion of the inner lip provided with a large number of short cross-plaits or folds. It is a very marked and characteristic genus, which next to *Volutilithes* has the most numerous representatives in eocene rocks; cretaceous species are as yet scarcely known, at least there is a great difficulty in attributing any of those which have been described, to it.

Gray has distinguished, besides *Lyria* (proper), a sub-genus *Harpella* and accepted *Enæta*. *Harpella* ought to differ in having numerous small grooves on the inner lip. The fact appears to be that the interstitia of the short posterior plaits are somewhat broader in *Lyr. (Harpella) costata*, Swains, (*lyrata* Humph.), than usual, the plaits themselves being somewhat obsolete. The *Lyr. Delessertiana*, Petit, has this character not nearly so distinct, and it is in fact scarcely possible to give any other generic distinction from *Lyr. mitraiformis*, Lam. The genus *Lyria*, as stated by Messrs. Adams in their 'Genera' ought, we believe, to be retained. The distinction of *Enæta*, Adams, would appear more desirable, the respective species being besides characterized

by a strong tooth on the interior margin of about the middle of the outer lip, but if species like *Voluta harpa*, Barnes, are to be transferred to *Lyria*, this character could no longer be of any importance. Most of the species are otherwise well characterized by a thick solid shell, a short spire and usually ribbed whorls; they approach in this respect most nearly to the *MITRINÆ*.

In a recent paper in the 'Journal de Conchyliologie' (1866. 3 ser., VI. tom. p. 105), Mr. Crosse re-established fully the genus *Lyria*, and recorded all its peculiarities, affinities to, and distinctions from, other allied genera.

One of the most important characters which has been added to those already specified by Dr. Gray and Messrs. H. and A. Adams, was the discovery of a *narrow, elongated and horny operculum* in *Lyria deliciosa*, Montf. and *Lyr. harpa*, Barnes. In a still more recent note (Journ. Conch. 1866, 3mc.Ser. VI mc. tom. p. 335), Mr. Crosse records the interesting fact, that the operculum of *Lyr. deliciosa* has first nearly a *central* and in more advanced age a *subapical* nucleus. Mr. Crosse draws the very natural conclusion, that most probably all the other species of *Lyria* possess a similar operculum. The author summarises his remarks in the following characteristics of the genus:

"*Testa ovato-oblonga, mitriformis, crassiuscula, plerumque (sed non semper) longitudinaliter costata; apertura subovata, leviter stricta; margine columellari ad basim valide biplicato, deinde plicis parviusculis, plus minusve numerosis munito, interdum ad parietem unidenticulato, margine dextro extus turgido, peculiariter inflato, ad limbum simplice, acuto.*"

"*Operculum ovato-elongatum, tenuisculum, corneum, supra concentricè sed inæqualiter rugoso-striatum, circa nucleum dextrorsum nec procul ab apice situm; subtus annulare.*"

"*Animal ignotum.*"

Mr. Crosse enumerates 14 species of recent *Lyriæ*, three of them, however, are doubtful, namely *Vol. guttata*, Reeve, *V. cylleniformis*, Sow., and *V. Guildingi*, Sow. Should the separation of the genus *Enæta* be found necessary, they have to be transferred to it; the other 11 species are quoted as true *Lyriæ*, among which the *L. mitræformis* and *L. Delessertiana* are probably the best known representatives.

From the cretaceous beds of South India, we have to notice three characteristic species.

1. *LYRIA FORMOSA*, Stoliczka. Pl. IX, Figs. 7 and 8.

Lyr. testa ovate-elongata, utrinque acuta, spira ultimo anfractu brevior; anfractibus parum convexis, transversim costulatis; costulis 14-18 in uno circuitu, prope rectis, postice ad suturam duobus sulcis spiralibus intercisis; ultimo anfractu antice spiraliter minute-sulcoso; apertura angustissima, antice atque postice acuta; labio multiplicato: plica antica ad marginem canalis maxima, posticis sensim tenuioribus.

Spiral angle 57°; sutural angle 11°.

Height of last whorl : total height of shell (taken as 1·00) 0·66.

This species can be readily distinguished by the large number of transverse ribs, which vary from 14 to 18 in one volution and are along the suture crossed by two

successive impressed lines, so as to cause in some respect the formation of two rows of small tubercles. The anterior portion of the last whorl is numerously and finely sulcated. The inner lip exhibits many oblique folds, of which the posterior ones are very thin and only the last anterior is considerably stronger, while in the living species of *Lyria* there are usually two stronger anterior folds. The species, although not rare, does not seem to attain a large size; the usual being 18mm. in height and 8mm. in width on the last whorl; the elongated and on both ends pointed form of the shell being apparently very characteristic.

Locality.—Ninnyoor in Trichinopoly district; occurring in whitish sandy limestone.

Formation.—Arriallor group.

2. *LYRIA CRASSICOSTATA*, *Stoliczka*. Pl. IX, Fig. 9.

Lyr. testa elongata, fusiformi; anfractibus subconvexis, costis transversalibus 8—9 in uno circuitu, crassis, prope rectis, in superficie spiraliter minutissime striatis; ultimo spira vix altiore; apertura valde compressa ac elongata; margine interiori incrassato, plicoso: plicis anterioribus fortioribus, posterioribus brevioribus.

Spiral angle about 32°; sutural angle 15°.

This is a very peculiar species distinguished by a great thickness of the shell, and although known only from the imperfect specimen figured, it is so very characteristic, that even small fragments could be again recognised from this. The number of whorls amounts to six or seven, each having 8 to 9 transverse, very thick ribs, extending from one suture to the other, being only slightly bent and nearly perpendicular; on the last whorl, which appears to have been somewhat higher than the spire, they are anteriorly recurved and terminate on approaching the inner lip, along which there is a thick swelling, indicating the presence of a strong emargination of the aperture on the anterior extremity. The entire surface is covered with very fine spiral striæ, besides which striæ of growth appear more or less distinctly marked. The aperture is long and narrow, and according to the bending of the canal curved in a similar manner. The outer lip, as well as the anterior termination of the canal, are not perfect in our specimen, but the plication of the inner lip exhibits the characters of this genus pretty well; the inner margin being folded in its entire extent. The folds increase in thickness towards the anterior extremity, the second one being apparently the strongest, the first anterior somewhat less in strength.

Locality.—Comarapolliam (North of Arriallor) in Trichinopoly district; out of conglomeratic siliceous sandstone.

Formation.—Arriallor group.

3. *LYRIA GRANULOSA*, *Stoliczka*. Pl. IX, Figs. 10 and 11.

L. testa elongata; anfractibus subconvexis, gradatis, transversaliter acute, spiraliter late-, costatis: costis transversalibus circiter 15 in uno circuitu, usque ad suturam, extensis, spiralibus in anfractibus superioribus quinis seu senis, in ultimo numerosis, omnibus latis, in costis transversalibus subtuberculatis, interstitiis profundis, fere æqualibus separatis; canali sinistrorse lateraliter curvato; labio multiplicato: plicis anterioribus fortioribus, minoribus nonnunquam alternantibus.

Spiral angle 37° ; sutural angle 10° .

The great number of sharp and nearly straight transverse ribs, which extend over the total width of each whorl, show a resemblance in this species to *Volutilithes radula*, from which it is readily distinguished by its more elongated form, the last whorl being nearly of equal height with the spire, while the same greatly exceeds the elevation of the spire in the other species. The spiral ribbings of *Lyr. granulosa* are remarkably broad, not very high, forming moderate tubercles, when crossing the transverse ribs; they vary from 5 to 6 on the upper volutions, and the two posterior or upper ones are placed closer to each other than the rest; an equally marked distinction from *V. radula*, Sow. Towards the anterior extremity the strength of the ribs decreases, and they are here often replaced by alternating rows of smaller and larger tubercles.

Although several specimens have been procured from the whitish sandstones near Koloture, none of them has the aperture perfectly preserved. The length of the canal may be calculated from the fragment on Pl. IX, Fig. 11; it was a little bent to the left side. The inner lip exposes a great number of plaits in its entire length, the anterior ones are strongest, and often alternate on the margin of the aperture with other short plaits; the posterior die out gradually, and, in consequence of the inner lip being thin, the spiral granulated rows of the shell-surface become apparent; this is also clearly visible in the figured fragment (Fig. 11), the columellar margin of which has been exposed for that purpose. According to a small specimen, which shows an original portion of the outer lip, this had a sharp margin, grooved internally as indicated by, though not dependent upon, the spiral ornamentation on the exterior surface.

Localities.—In whitish sandstone near Koloture, and in a similar sandy-limestone between Andoor and Veraghoor, in the Trichinopoly district.

Formation.—(?) Trichinopoly group, both the mentioned localities are, however, close to the uncertain boundary of the Arrialoor group, and the mineralogical character of the rock is the same as that of the typical Arrialoor sandstone from the neighbourhood of Arrialoor, so the species may rather be looked for in the Arrialoor beds, should these remain separated from the Trichinopoly group.

c. Sub-family—*VOLUTOMITRINÆ*.

(Vide Gray's Guide, 1857, p. 36; Adams' Genera, II, p. 619.)

XX. VOLUTOMITRA, Gray, 1847.

Gray has separated lately the genus *Volutomitra* in a sub-family of his *VOLUTIDÆ* on the ground of the middle tooth of the lingual membrane being stronger, with a cone-like apex. The shell of *Volutomitra* itself may be said to have as much resemblance to the *VOLUTINÆ* as to the *MITRINÆ*, with the former of which it agrees generally in the smoothness of the shell or at least the want of any stronger transverse ribs, while the columellar plaits are arranged more like to those of the *MITRINÆ*. In so far there appears every reason for supposing, that the differences pointed out by Dr. Gray have a classificatory value, and that the sub-family may stand as indicating a passage from the *VOLUTINÆ* to the *MITRINÆ*, in which case there is by far less reason to separate the latter sub-family altogether from the *VOLUTIDÆ*. The same author says, that the tentacles of *V. Groenlandica* are close at the base, the eyes one-third above the base (but on large tubercles!) and the siphon simple, which evidently agrees much more with other *MITRINÆ* than with the *VOLUTINÆ*.

There are several fossil tertiary species, which belong to this group. None of the *MITRINÆ* described from cretaceous rocks exhibits, however, the characters of the genus, and the species, which we here refer to it, may be said to agree only *exteriorly* with it, as we have not been able to procure a quite perfect specimen.

1. VOLUTOMITRA CANALICULATA, *Stoliczka*. Pl. IX, Figs. 12 and 13.

Vol. testa ovate-elongata; anfractibus quinis, convexis, prope suturam canaliculatis, spiraliter numerosissime atque minute-sulcatis, seu striatis: striis in medio ultimi anfractus subobsoletis; apertura angusta, elongata, antice atque postice subacuta; canali lateraliter curvato, prolongato; labio triplicato, plica antica tenui, duobus posterioribus crassioribus, fere æqualibus.

Spiral angle 60°; sutural angle 10°.

Height of last whorl : total of shell (considered as 1·00°) 0·63.

An ovately elongated shell composed of about five convex volutions, the last exceeding the spire in height. Below the suture there is a distinct broad furrow on all whorls, the margin of the suture itself being marked by an elevated line, and a similar line is distinguished on the last whorl below the furrow, being bounded on either side by an impression. All the other surface of the shell is densely covered with fine spiral striæ and sulci respectively, both becoming usually obsolete on the middle of the last whorl and also partially so on the upper volutions of the spire. The aperture is much elongated, being laterally compressed and pointed on each end. The canal is produced and bent a little to the left side (in front view), and more so than usually in living species of the same genus. There are three folds on the inner lip, the two posterior stronger and about equal, the anterior somewhat thinner

It is, however, possible, that a fourth small anterior plait might exist, our specimen being in this respect not quite perfect.

Locality.—Near Serdamungalum, in a blueish calcareous sandstone, apparently rare.

Formation.—Trichinopoly group.

d. *Sub-family*—*MITRINÆ*.

MITRANA, Gray's Guide, 1857, p. 29.

The animals of the *MITRINÆ*, so far as known, differ in many respects from those of the *VOLUTINÆ*. The foot is triangular, moderately expanded, the siphon long, without any auricles, the tentacles long, bearing the eyes near the basis, but usually within their length. The teeth are in three series, the central of which are broad and denticulated, but exhibiting great variations. It appears, that from a middle central tooth, resembling in all respects that of the *VOLUTOMITRINÆ* and *SCAPHELLINÆ* of Gray, furnished on each side with very small denticles (*Mitra adusta*), a gradual change can be traced to a broad many-denticulated central tooth, so that through the two above-mentioned sub-families the *MITRINÆ* seem in this respect also to be more (or at least quite as much) allied to the *VOLUTINÆ* than to the *FASCIOLARIDÆ*. With the latter family they have been classed by Gray, while H. and A. Adams unite them with the *COLUMBELLIDÆ* in one family. We prefer the older classification in the family *VOLUTIDÆ* to any of these, because the shell has through its consistency and shortness of the canal absolutely much more relation to other *VOLUTIDÆ* than to any *FASCIOLARIDÆ*, and as on the other hand the *COLUMBELLIDÆ* have strictly no columellar plaits, but a *plicated margin* of the aperture only.

None of the *MITRINÆ* are as yet known to have an operculum, like the larger number of the *VOLUTIDÆ*, while the *FASCIOLARIDÆ* have an ovate lamellar operculum much like the *FUSINÆ*, to the shells of which they present certainly the greatest relationship.

I have already noticed, that even with the separation of the *VOLUTOMITRINÆ*, many shells of the *MITRINÆ* are in no other way separable from the *VOLUTINÆ*, except in having the uppermost plaits the strongest and the anterior gradually smaller and thinner. There are indeed only a few exceptions to prevent this distinction being made quite practicable, and to cause other characters to be considered more conclusive, as, for instance, some species of *Cylindra*, Shum. and even *Zierliana*, Gray.

That a distinction of the *MITRINÆ* into several genera is quite as necessary as that of the *VOLUTINÆ*, must be certainly acknowledged in considering such characteristic forms as *Scabricola*, Swains., *Turricula*, Klein, *Zierliana*, Gray and others, but the number of the restricted, or so called, sub-genera is by no means settled. We agree fully with Chenu, when he considers the genera and sub-genera of Swainson, H. and A. Adams and Gray as of equal value, and with probably few exceptions they seem to be so in reality, so that such a desirable separation and classification ought to be at

once carried out in practice. No smaller number would probably allow of a classification of the fossil species, which in neogene and eocene beds are very numerous. Some new types will also have to be added.

The cretaceous representatives are comparatively few, and many of them very doubtful as belonging to this sub-family in consequence of their bad preservation. The following species have to be transferred to *Turricula*: *Mitra cancellata*, Sow. (*id.* et *M. Cassisiana* D'Orb.); *M. clathrata*, Reuss, (much resembling the new species here described as *Turricula Arrialoorensis*); *M. Rœmeri*, D'Orb.; *M. Leopoliensis*, Alth; *M. nana*, Müll.; *M. Voitii*, Binkh.: to *Imbricaria* (*Conohelix*, Swains.) probably belong *Mitra conoidea*, Math. and *M. Limburgensis*, Binkh. and it is, as I stated on p. 73, not certain whether this genus, and perhaps *Cylindra* too, ought not to form with *Gosavia* a separate sub-family in the CONIDÆ. The *M. Cenomanensis* and *gracilis*, Guer., and *M. Requièni* and *Vignyensis*, D'Orb. I have not been able to trace. If these prove correct, and the *Mitra cretacea*, Gabb (Pal. Calif. I, 1864, p. 102, Pl. 28, Fig. 215) with the two Indian species be included, the number of known MITRINÆ will be at the present not more than fifteen. This small number, as compared with the great variety and richness of the recent fauna, is very remarkable.

Pictet quotes 19 species of *Mitra*, excluding the two Indian and one American (Mat. p. 1. Pal. Suisse, 1864, 3me Ser. II, pt. p. 682-684). Of these 19 species the following have however to be most probably excluded: *Mit. Murchisoni* and *pyruliformis*, Müller as *Fulguraria* and *Ficulopsis* of the VOLUTINÆ respectively; *M. Cassisiana*, D'Orb. as not different from *M. cancellata*, Sow.; *Mitra reticulata*, D'Orb. = *Cerith. reticulatum*, Rœmer, Pictet and others. Mr. Rœmer does not mention anything about columellar plaits, and the species must be retained for the present as a *Cerithium*, although it might belong to *Chemnitzia* or *Turbonilla*. Of *Mit. Zekelii*, *nitida* and *spinosa* from the Alpine Gosau deposits the first two have, I believe, to be retained under *Fasciolaria* and the third as *Borsonia*, as stated in my Revision of the Gosau-gastropoda, p. 87 (Sitz. Akad. Wien. 1865, LII.)

I have quoted the *Fasc. gracilis*, Zek. (*Mitra Zekelii*) Pict. et Camp., as a *Mitra* (loc. cit. p. 79), but having examined some very similar forms from South India, I am rather convinced that the species is better placed in the genus *Fasciolaria*, as the insinuations of the ribs correspond with a similar notch of the outer lip, which is quite foreign to any known species of the MITRINÆ. Besides this the shell is much thinner and the canal evidently longer, than even in *Turricula cancellata*, Sow. sp. and others. The *Mitra nitida*, Pictet and Camp. = *Fasciolaria nitida*, Zek. is identical with the original *Fasciolaria elongata*, Sow. (*Vide* my Revision. loc. cit. p. 84). One or two new species occur in the Alpine Gosau deposits, but they have not yet been described.

XXI. MITREOLA, *Swainson*, 1840.

(*Vide* Adams' Genera, I, p. 174. Chenu's Manual, I, p. 194).

The recent species of this genus are through their thickened form of shell, occasionally obsolete transverse ribbings and specially through the papillar structure of the apex, closely allied to the *VOLUTINÆ*; and as the outer lip is sometimes thickened internally about the middle of its extent, it is difficult to distinguish them from *Enæta* by any other character than the stronger posterior plaits of the inner lip.

We refer to this genus the *Voluta citharina* of Forbes on the ground of the last-named characteristic of the columellar plaits.

1. MITREOLA CITHARINA, *Forbes*, *sp.* Pl. IX, Fig. 14.

1846. *Voluta citharina*, Forbes, Trans. Geol. Soc., Lond. VII, p. 132, Pl. 12, Fig. 8.
idem, D'Orbigny, Gabb, Pictet, etc.

Mit. testa subfusiformi, ovata, ultimo anfractu spira in altitudine vix longiore; anfractibus subconvexis, ad suturam subangulatis, transversim multicostulatis, spiraliter striatis, costulis prope rectis acutisque, una stria prope suturam fortiore atque sulco lato ceteris sejuncta; labio antice quadriplicato.

Spiral angle 45°; sutural angle 7°.

Besides the elongated ovate form of the shell, the spire being about or very nearly as high as the last whorl, the principal character of this species lies in the ornamentation. There being between 18 and 20 transverse ribs present, slightly curved, sharp, crossed by numerous spiral, flat striæ of equal strength on the ribs as well as in the furrows separating them. On the posterior margin of each whorl next to the suture there is a slight swelling and to this follows one of the striæ markedly stronger than all others, and bounded on each side by somewhat broader sulcations; this produces a slight edge near the suture. The aperture is very narrow; the inner lip exposes anteriorly four distinctly oblique folds, placed closely to each other and gradually becoming thinner towards the anterior canal. This last character combined with the total form of the massive shell induces us to place the species rather under the *MITRINÆ* than in the *VOLUTINÆ*, where it has up to this been classed. We have seen only fragmentary specimens belonging to the Madras Museum; they are in a blueish calcareous sandstone, such as the mineralogical character of the Pondicherry fossils usually exhibits.

Locality.—Pondicherry.

Formation.—Valudayur or Arrialoore group. (?)

XXII. TURRICULA, *Klein*, 1753.

(*Vide* Adams' Gen. I, p. 175, Chenu's Man. I, p. 194.)

This genus ought to be restricted for *fusiform shells with a much produced anterior canal* only, in which character they stand next to the *FASCIOLARIDÆ*. The number of plaits varies from three to five.

It would probably be better to form a new generic group for those cretaceous species, of which *Mitra cancellata*, Sow. (*id.* D'Orb., Binkh. a. o.) *Mit. Vaelii*, Binkhorst (Monog. pl. V,²³ fig. C.), the here noted South Indian, and other forms may be considered the types. They differ from the great number of species of *Turricula* by a more produced and attenuated canal; but as the margin of the outer lip has not been in any of those species traced perfect with full certainty, and as through the loss of this the above-mentioned difference becomes undoubtedly more exposed, it may for the present not be advisable to anticipate that distinction.

Most of the cretaceous species described as *Mitra* belong to this generic group.

1. TURRICULA ARRIALOORENSIS, *Stoliczka*. Pl. IX, Figs. 15 and 16.

Turr. testa fusiformi; anfractibus prope planis, transversaliter costulatis, spiraliter striatis; costulis 14-20 in uno circuitu, parum curvatis, in superioribus nonnunquam obsoletis; striis planis, latioribus atque angustioribus alternantibus; apertura angustissima; canali antico moderate longo, attenuato; labio quadruplicato.

Spiral angle 32°—35°; sutural angle 9°.

The whorls are nearly flat and ornamented with from 14 to 20 transverse ribs, which are slightly curved on the last whorl, the upper portion of each rib—remaining visible on the upper whorls—being straight or even bent in the opposite (to the right) direction. Numerous spiral striæ and sulcations respectively cover the surface, they are generally alternating, unequal in width, but on the transverse ribs very slightly marked. The finer ornamentation of the shell varies a great deal and seems to depend very much on the state of preservation. Occasionally specimens are met with, which have a larger number of transverse ribs, in which case they usually become quite obsolete on the uppermost whorls. When in addition the spiral striation is a little more sharp, such specimens have then a great resemblance to *M. cancellata*, Sow.,* but I have never observed any granulation on the surface of the Indian shell, and even when the ribs are sometimes more numerous than is shown in the figured specimens, the spiral striæ remain apparently always faintly marked. The anterior portion of the canal is prolonged and rather thin, as in *M. cancellata*; the inner lip has four oblique folds, the anterior ones being thinner.

Locality.—Near Comarapolliam in Trichinopoly district.

Formation.—Arrialoore group.

* D'Orbigny separates (Prod. II, p. 154) the *M. cancellata*, Sow. of the Pal. franç. as distinct, under the name of *M. Cassisiana*, evidently on account of there being only three folds represented in the figure of the French species. It is possible that he is right, but certainly it would be a singular case of a *Mitra*, if his specimen had no other fold on the whole space between the three folds marked and the termination of the canal. D'Orbigny's specimen as figured exhibits otherwise no distinctions from the Gosau species, and I believe they are identical.

IX. *Family—FASCIOLARIIDÆ.*

It would be desirable, we believe, to unite the usually so-called *FASCIOLARIIDÆ* and *TURBINELLIDÆ* (with the exclusion of the *MITRINÆ*) into one family, and to distinguish them as sub-families only. The shells are generally easily separable from those of the *VOLUTIDÆ* by the length of the canal, although strict limits can scarcely be drawn. The animals of both are, however, very like, but at the same time considerably different from those of the *VOLUTIDÆ*.

The head is never very distinctly separated from the body; the tentacles are subulate, of moderate length, with the eyes on bulgings within their length, that is the eyepedicles are united with the tentacles for some distance; the teeth are on a lingual membrane in three series, the middle ones appear to be usually with three denticles; the lateral with numerous denticles in the *FASCIOLARIINÆ* and single in the *TURBINELLINÆ*; the foot is moderately expanded with folded margins, and bears always an ovate lamellar operculum with an apical nucleus.

a. *Sub-family—TURBINELLINÆ.*

(*VASIDÆ*, Adams; *TURBINELLIDÆ*, Gray, Chenu and others.)

It cannot be questioned that the shells of this group, as restricted by later conchologists, are easily distinguished from those of the next, the columellar plaits being in the middle of the columellar lip, usually very strong, and not very oblique, the shell itself consistent, thick, and not uncommonly covered partially with an enamel coating. The two principal genera, best known as *Turbinella* (*Turbinellus* or *Mazza*) and *Scolymus* (*Vasum*, *Cynodona* or *Cynodonta*) are very marked, the first actually agreeing much more with the *VOLUTIDÆ* than with any other *FASCIOLARIIDÆ*, although the examination of the animals leaves no doubt as to their difference. When we compare, however, the species of *Leucozonia* of the *FASCIOLARIINÆ*, we find that the shell is in its consistency much more of the character of the *TURBINELLINÆ* than of the *FASCIOLARIINÆ*, and that some of the species, very similar among themselves, have the plaits less oblique and of nearly equal strength, while in others they are placed exactly in a manner similar to that in typical *Fasciolaria*. For this reason only we would propose to treat these two usually called families under one name, because they certainly do not exhibit a greater difference than for instance do the *MITRINÆ* and *VOLUTINÆ*, or the *FUSINÆ* and *MURICINÆ*, being respectively parts of the families *VOLUTIDÆ* and *MURICIDÆ*.

There are very few fossil species known, which belong to the *TURBINELLINÆ*, as restricted. Most of the tertiary *Turbinellæ* belong to *Latirus* and *Leucozonia*. It is possible that some of the eocene *Volutæ*, as *V. muricina* and others, have more relation to *Scolymus*, than they certainly have to *Volutilithes* or other positively known *VOLUTIDÆ*, but the means of ascertaining such a point in fossil species are soon exhausted. The cretaceous number is still a smaller one. Binkhorst (Monog. Gast. et Ceph. Limbg, 1861, pp. 65 and 66), described *Turbinella supracretacea* and *plicata*, two forms very like each other, and which, if farther researches prove

them to be correctly determined, must be classed in this group. There is a little discrepancy, I believe, between Binkhorst's figures, which requires explanation. The two species are known from impressions and casts only, but in the Fig. 9b, Pl. V³ of *T. plicata* the spiral striae show such a direction as could be explained only by a pressure of the specimen, which, however, is not apparent in the figure. The upper volutions of the two *Turbinellæ* and of *Imbricaria Limburgensis*, Binkhst. (*loc. cit.* Pl. II, Fig. 8,) are exceedingly like, while the outline of the outer-lip in the last species does not show that form at all, although it appears to be otherwise perfect. I notice these points merely as doubts arising from the inspection of the figures, but I had never an opportunity of seeing any of these valuable specimens, and apparent identity may be in reality great distinction. There is unquestionably much to be anticipated from well preserved specimens.

Gabb described two cast-specimens as *Turb. subconica* and *parva* (Proceed. Acad. Nat. sc. Phil. for 1860, publ. 1861, p. 94, Pl. 2, Figs. 6 and 3) from New Jersey; but the specimens being far from perfect even as casts, it is difficult to form an opinion about them.

b. Sub-family—FASCIOLARIINÆ.

The principal character of this sub-family lies in the disposition of the columellar plaits, these being present only on the fore-part of the inner lip along the canal, and the anterior plait being usually the strongest. There are only very few, and these only partial, exceptions to be met with in one or two species of *Leucozonia*, where the middle plaits are stronger and those along the canal somewhat thinner.

The shells exhibit great variety in shape, from shortly-ovate to elongated-fusiform, but the canal is always considerably produced. There seems to be at the present no great necessity for establishing more genera than stated by Gray (Guide, 1857, p. 28), namely *Fasciolaria*, *Latirus* and *Leucozonia*. I do not, however, consider the question as to their classification in the FASCIOLARIINÆ at all settled. It appears doubtful whether it would not be better to separate *Leucozonia* and a few species of *Latirus* and *Fasciolaria*, marked by a great thickness of the shell, into a separate sub-family, and those with a thin shell, most nearly resembling *Fusus*, into another sub-family. I am only little acquainted with the numerous living species, but nearly all the fossil forms belong to the group with a thin shell. In this latter group very similar generic or sub-generic separations could be made as among the FUSINÆ.

Adams and accordingly also Chenu, classed *Tudicla*, Bolt., *Busycon*, Bolt. and *Fastigiella*, Reeve, in this sub-family. It appears that *Tudicla* belongs rather to the PURPURIDÆ next to *Rapa*; *Busycon* was subsequently transferred by Adams (Genera, II, p. 655) to the FUSINÆ and *Fastigiella* to the CERITHIIDÆ. This classification is no doubt more correct. There are several tertiary species, known as *Cerithium*, which must then be classed under *Fastigiella*, although, in having a slight insinuosity on the lower portion of the outer lip, they recall very much *Phos*, Montft.; and it appears not quite certain, whether these two ought not to form a separate sub-family in the BUCCINIDÆ. Scarcely any Jurassic species of FASCIOLARIINÆ are known. Piette mentions (Bull. Soc. Géol. France, 1856, XIII, p. 593, Pl. XV, Figs. 15 and 16)

a *Fasc. nuda* from the great Oolite of Eparcy; the figured specimen is rather imperfect, but approaches in form to a young *Fasciolaria*. D'Orbigny names in Prod. II., p. 291, from his *étage danien*, two species *F. prima* and *supracretacea*; both these species are in every other respect unknown.

Gabb described in Journ. Nat. sc. Phil. 2d. ser. iv, p. 390, Pl. 68, Fig. 6, a *Fasc. Saffordi* from Tennessee, and ? *Fasc. læviuscula*, ? *Fasc. Io*, *Fasc. sinuata* from the cretaceous beds of California (Pal. I, 1864, pp. 100 and 101.) Neither of the species are so far perfect that it could be ascertained whether they belong to *Latirus* or *Fasciolaria*, but the form (except in the second-named) agrees rather with that of *Latirus*.

In my revision of the Gastropoda of the Gosau formation (Sitz. Akad. Wien, 1865, LII, p. 84) I have mentioned *Fasc. elongata*, Sow. (*Fasc. nitida*, Zek.) *Fasc. torquilla*, Zek. and *Fas. baccata*, Zek., the last of these must be certainly referred to *Latirus*, but I have not seen sufficiently perfect specimens of the two others. The *Mitra Zekelii*, Pict. et Camp. (*ibid.* p. 79. *Fasc. gracilis*, Zek.) must be retained as *Fasciolaria*. To this number of ten species already known we have to add from the South Indian cretaceous rocks four, *Lat. Reussianus*, *Fasc. carnatica*, *rigida*, (Baily sp.) and *assimilis*.

Other species which have been described under *Fasciolaria* must be excluded and will be found noted in the other groups.

XXII. LATIRUS, Montfort, 1810.

(Adams' Gen. I, p. 152; Chenu's Man. p. 181; Gray's Guide, 1857, p. 29).

The short canal, strong transverse ribbings, resembling the varices of the *TRITONIDÆ*, and the spiral elevated striæ or waved lines unite a large number of species, which form in a certain way a transition from *Leucozonia* to *Fasciolaria*. The columella is usually fissured, but in the process of growth the fissure is filled with the callosity of the inner lip, and in rare cases only it remains open. The columellar plaits are always very faint and in young specimens scarcely traceable. Adams separates *Peristernia*, Mörch, as a distinct genus, but the characters of distinction which he gives cannot be retained. I believe, however, that several of the species, which he refers to that genus, as *F. crenulata*, *gemmata* of Reeve, and others, having exteriorly a more thickened outer and a grooved, but not plicated, inner-lip, belong to *Hindsia* of the *TRITONIDÆ*.

1. LATIRUS REUSSIANUS, Stoliczka, Pl. X, Figs. 1—4.

Lat. testa fusiformi; anfractibus senis—octonis, ad suturam impressis, transversim costulatis, spiraliter striatis: costis denis seu duodenis in uno circuitu, ad marginem postertorem subobsoletis, striis plus minusve lamellosis seu crenulatis; apertura ovate-elongata, antice-angustata; labro in margine acuto, intus sulcoso; labio calloso, tenui, obsolete triplicato; columella antice fissurata, ad terminationem paululum recurva.

Spiral angle 46°—50°; sutural angle 8°.

Height of last whorl: total of shell (consd. as 1.00) ... 0.52—0.56.

This species resembles so much *Fusus Reussii*, Zek. (Gosau Gastrop. Wien, 1852 p. 86, Pl. 15, Fig. 11, and Sitzb. Akad. Wien, 1865, LII, Rev. etc. p. 81), that their

identity may be proved in time. I never had occasion to observe any columellar plaits on the Gosau-species, but they may have been only obliterate and not visible from the want of a satisfactory state of preservation. In the present Indian species, the folds are so faint, that in scarcely one out of ten cases are they distinctly marked, and as all the rest regarding form and ornamentation of shell agrees well with the above-mentioned species, it is certainly desirable to draw attention to this point in any future examination. I am at present in doubt whether such faint plaits do not exist in the Gosau species described by Zekeli (*ibid.* p. 74, Pl. 13, Fig. 8) as *Voluta torosa* and transferred by me to *Fusus* (Sitzb. 1865, LII. p. 83); if this be the case, all the three forms must be united under one name. It is even questionable whether the *Fasciolaria torquilla*, Zek. sp. (*Cancellaria id.* Zekeli, loc. cit. p. 81, Pl. 14, Fig. 11) could be kept as distinct; but it has the folds much stronger. The transverse ribs of the present species become above towards the suture of each whorl nearly obsolete, which is specially due to a greater or lesser contraction of the whorls. The spiral striæ are originally pretty strong, numerous and very close; they are crossed by numerous fine lamellar striæ of growth, which occasionally produce a fine granulation on the former.

The outer lip is sharp, and on the margin internally grooved; the inner lip always leaves a small fissure visible near the termination of the columella; close to the posterior end it is only slightly toothed.

Localities.—North of Alundanapooram, Andoor, and E. of Anapaudy, in Trichinopoly district; not rare.

Formation.—Trichinopoly group.

XXIV. FASCIOLARIA, Lamarck, 1792.

(Adams' Genera, I, p. 150; Gray's Guide, 1857, p. 28; Chenu's Manual, I. p. 180.)

1. FASCIOLARIA CARNATICA, Stoliczka, Pl. X, Figs. 8 and 9.

Fasc. testa fusiformi; anfractibus convexis, ultimo spira longiore, spiraliter minute sulcatis, transversim striato-costulatis; costulis supra prope rectis, in ultimo anfractu parum S-forme curvatis atque prope aperturam evanescentibus; canali ad terminationem paulum incurvo; columella triplicata.

Spiral angle 40° ; sutural angle 17.5° .

Height of penultimate whorl : that of the spire (consd. as 1.00) ... 0.37.

Height of last whorl : total of shell (consd. as 1.00) ... 0.74.

The whorls, usually about six in number, are regularly convex, broadest in the middle, the last considerably longer than the spire. The surface is covered with numerous spiral striæ, and transversal ribs. Of the latter there are from 16 to 20 in one whorl, nearly straight and equal in their entire extent, not tuberculated at the suture, as in *Fas. assimilis*, n. sp. While the spiral striæ increase in strength with age, the transverse ribs disappear gradually altogether, being at first less numerous. The canal is at its termination slightly bent inwards, and the columella exhibits

three folds, the lowest of which is the strongest. As regards general form and character of the ornamentation, this species much resembles *Pleurotoma fenestrata*, Zek. (Gastrop. Gosaugebild. 1852, Pl. 16, Fig. 9), of which I have stated in my revision (Sitzungsb. Akad. Wien, LII, p. 87), that the single specimen figured by Zekeli does not admit of certain generic determination, the surface being quite eroded and disfigured. I do not think it impossible, that these too may prove to be identical.

Localities.—Olapaudy, and neighbourhood of Karapaudy; the species appears to be rather a rare shell.

Formation.—Arrialoor group.

2. FASCIOLARIA RIGIDA, *Baily, sp.* Pl. X, Figs. 10—16.

1855. *Voluta rigida*, Baily, Quar. Jour. Geol. Soc. Lond. XI, p. 459, Pl. 12, Fig. 4.

Fasc. testa fusiformi, elongata; anfractibus numerosis, scalariformibus, postice valde contractis, ad marginem suturalem tumescentibus ac plus minusve crenulatis, infra crasse-costatis: costis ad angulum nonnunquam subtuberculatis, paulo obliquis, in ultimo anfractu antice obsoletis; superficie spiraliter dense-striata: striis in excavatione posteriori anfractuum tenuioribus; columella 4—5 plicata, plica anteriori crassissima, superioribus sensim tenuioribus, posticis aliquantisper fere obsoletis; canali prope recto, prolongato.

Spiral angle 45° — 50° ; sutural angle 10° .

Height of last whorl : total of shell (comsd. as 1.00) 0.54—0.60.

The shell of this species is subject to a little variation as regards the length of the spire, this being more or less short than the last whorl, as may be seen by a comparison of the several figures given on Pl. X. The spiral striæ are very numerous, coarse and nearly all of equal strength, except those below the suture on the excavated portion of the shell, where they are usually somewhat thinner. The margin along the suture is always thick, swollen up and more or less crenulated or even tuberculated. The transverse ribs are either very slightly bent or they are straight and become obsolete posteriorly on all, and anteriorly on the last, whorl. There are, however, not unusually cases to be met with, where the spiral striation on the surface of the shell is much worn off, and in such cases the transverse ribs can be traced extending nearly up to the suture. The outer lip is sharp, internally grooved; the inner lip exposes four or five oblique plaits, the posterior one or two being very fine, but not always traceable; the anterior, next to the canal, is always the strongest.

Although the existence of plaits on the columella would make the identity of this species with *Voluta cincta*, Forbes, more probable, than that of *Hemifusus cinctus* n. sp. (described on p. 114) with the same, the total want of any thinner spiral striæ between the principal ones and the elongated spire are rather opposed to this. The question of identity ought, however, not to be given up on this account, but it can scarcely be settled in any other way than by a comparison of Forbes' originals. Baily's figure of *Vol. rigida* represents a specimen apparently with shorter

spire, about equal to one of ours represented in Fig. 18 on Pl. X, but it does not exhibit the slightest difference in the ornamentation, for which reason I believe it to be identical. Baily says, that the columellar plaits were not visible in the specimens, which he examined, and this would be the only point in which a difference could be expected.

This species is very common in the Trichinopoly district, and the largest specimens procured attain a height of 100mm. The following are the principal:—

Localities.—Andoor, Coonum, Shutanure, Anapady, Alundanapooram and Serdamungalum.

Formation.—Trichinopoly group.

3. FASCIOLARIA ASSIMILIS, *Stoliczka*. Pl. X, Figs. 5—7.

Fasc. testa fusiformi, attenuata; anfractibus ad medium convexis, infra suturam constrictis, spiraliter dense striatis, transversim costulatis: costulis ad suturam sub tuberculatis seu tumescentibus, supra ad medium sinuose-incurvatis; ultimo anfractu spira longiore, antice canali longo extenso; columella ternis plicis obliquis atque crassis ornata.

Spiral angle 30° ; sutural angle 16° .

Height of last whorl : total height of shell (taken as 1.00) ... 0.54.

Height of penultimate whorl : height of spire (consd. as 1.00) ... 0.35.

This species is very well characterised by its much elongated form, great height of the single whorls, the numerous fine spiral striæ and the transversal ribs, which at the suture often terminate in small tubercles, and below the constriction of the whorls are strongly bent inwards. This curvation of the ribs corresponds with a similar shallow notch on the outer margin of the aperture. On young specimens the transverse ribs become occasionally nearly obsolete on the last whorl. The largest specimen from Olapady measures 140mm., and some fragments would indicate even a greater height, they have then a tolerably strongly developed keel at the place, where the ribs are insinuated, forming blunt tuberculations. This species resembles much *Mitra Zekeli*, Pict et. Camp. (*Fasciolaria gracilis*, Zekeli, Gastropoden der Gosaugebilde, Wien, 1852, p. 93, Pl. 16, Fig. 12; *Stoliczka* in Sitzungs. Akad. Wien, LII, p. 79); but as this is known from very imperfect specimens only, I do not think it safe to identify our fossil with it. The transverse ribs seem to be in the Gosau species bent nearer to the middle of the whorls, which appear to be also somewhat thinner; no spiral striation has been observed, although it no doubt exists.

Localities.—Olapady, Comarapolliam, S. W. of Mulloor, Karapady; not very common.

Formation.—Arrialoor group.

X. Family—*MURICIDÆ*.

(Adams' Genera, I, p. 70; Chenu's Manual, I, p. 133).

The animals of the *MURICIDÆ* have the head always somewhat lengthened, not thickened, truncate in front; tentacles moderate with united eyepedicles near the base; teeth in three series, the central fixed, usually three-lobed, the lateral versatile, single or at least not numerously hooked; the foot is moderate, never much expanded; the mantle enclosed with an anterior siphon, which is never much produced beyond the length of the canal of the shell.

Operculum annular, horny, ovate with an apical or subapical nucleus; (not known in *Hemifusus*).

The shell is *spiral, ovate or fusiform, usually ornamented with transverse varicose ribs and anteriorly produced into a more or less elongated canal, being notched at the end*. The remainders of the outer lip, forming transversal varix-like ribs, are characteristic for most species and genera, there are, however, a few as *Clavella*, *Neptunea* and others, where the varices become nearly or are actually quite obsolete, although the preponderance of the other characters does not allow us to exclude these forms. It is well known that the exterior ornamentation varies much according to the localities in which the species live, and this can therefore be regarded always only as a quotation of a large sum of distinctive characters. A general description of the shells must necessarily be very extensive, and we prefer, therefore, to attach it to the sub-families, of which the following have been proposed partially by previous authors; *FULGURINÆ*, *FUSINÆ* and *MURICINÆ*.

Dr. Gray (Guide, 1857) adds to the *MURICIDÆ* the sub-divisions *PISANIANA*, *COMINELLINA* (= *COLUMBELLIDÆ* in parte), *NASSINA* and *PHOSINA*, the two former of which may undoubtedly be better treated as a separate family, and the two latter in the family *BUCCINIDÆ*. On the other hand Gray separates the species of *Hemifusus*, *Fulgur*, and others into a distinct family, which he calls *CASSIDULIDÆ*; but there seems to be scarcely necessity for such a thorough separation, that of a sub-family is quite sufficient.

Münster (Beiträge etc. 1841) figures (Pl. IX. Fig. 38) a *Fusus Orbignyanus* from the triassic beds of St. Cassian and in an abstract of Dr. Laube's "Fauna of the St. Cassian beds" in the Sitzb. Akad. Wien, Vol. LIII, this fossil has been retained under the same name. The species is not a *Fusus* in the restricted sense of the genus, but not having had an opportunity to examine the species, we cannot of course say whether it does or not belong to the *FUSINÆ*. The three other species described and figured by Count Münster (*ibid*, p. 123) are much less *Fusus*, and do not even belong to the family *MURICIDÆ* at all. There are a number of jurassic species grouped with *Fusus*, but none of the species as yet found is so far perfect as to determine even the sub-family with the requisite accuracy. Deshayes suspects, that all the jurassic and older *Fusus* are only mistaken *Rostellariæ* (*ALATA*), and for several species this has been already proved to be actually the case; so we may expect some farther alterations. There is, however,

no reason that jurassic forms, like *Fusus Pietti*, Heb. and Desl. (Bull. Soc. Linné. Norm. 1860, V, p. 172, Pl. VIII, Fig. 6), could not belong to the *FUSINÆ*, although it is certainly necessary to examine the specimens strictly and compare with the top whorls of the *ALATA*, which occur with them.

Of cretaceous species about one hundred are known, possibly a few more; they range from the lower Neocomien into the uppermost beds of the chalk. Many of them are true *Fusus*, others belong only to the sub-family *FUSINÆ* and partly to that of the *FULGURINÆ*, but for the larger number of species we are still in great want of well preserved specimens, and, until these have been procured, many doubtful points cannot be settled. Most of the cretaceous species, which were known up to 1864, are catalogued by Pictet in his *Materiaux p. l. Paléontologie Suisse*, 3me. ser., p. 642, although of many of them (as I shall more particularly notice hereafter) we know in reality nothing more than the mere name.

a. Sub-family—*FULGURINÆ*.

(*CASSIDULIDÆ*, Gray, Guide, 1857, p. 10.)

We propose this name for the sub-family, simply because it is the least liable to be mistaken with any of those previously adopted. Three genera can be distinguished in this group, *Melongena*, Shum. 1817 (*Cassidulus* of Adams and Gray, the name not being traceable with certainty); *Fulgur*, Montf. 1810 (*Busycon* of Adams and Chenu, a name which is equally not traceable), and *Hemifusus*, Swains. (*Cochlidium*, Gray). H. & A. Adams consider *Myristica*, Swains. and *Volema*, Bolt., (or *Pugilina*, Shum.) as sub-genera of *Melongena*: I believe they are not even that, as they seem to refer chiefly to young shells of *Melongena* and *Fulgur*. The similarity is in fact very remarkable, which young specimens of *Melongena* exhibit as compared with *Fulgur* and *Hemifusus*, and the question as to the limit of these latter appears to be far from settled. The species are chiefly known from single shells, and although the animals of several of them have been observed, only few of the shells have been noticed in different stages of growth, which seems to be very important, for they show remarkable alterations in the form in different stages of age.

Adams and Chenu distribute the forms into the *FUSINÆ* and *FASCIOLARIDÆ* and it is due to Dr. Gray to state, that he drew attention to some peculiarities as to the shell and the animals of those species, which ought to form this separate group.

The head is much elongated and the tentacles very short with much thickened basis, and the eyes on bulgings on the upper external sides.

The operculum is ovate with apical nucleus, but it is not yet known in *Hemifusus*.

The shell is remarkable for the great size of the last volution, which is ventricose, enveloping the greater part of the previous whorls, and when produced into a longer canal, as in *Fulgur* and *Hemifusus*, it is slightly notched at the end; when less produced, as in *Melongena*, it is deeply notched. The spire is comparatively short,

the whorls angulate below the suture and usually ornamented with spines, or tubercles corresponding with a notch on the posterior margin of the outer lip, which is sharp, and occasionally internally striated, when the shell is thinner; the inner lip is always quite smooth, in younger specimens often angulated along the canal, but not furnished with a separate plait.

There are numerous fossil tertiary and cretaceous species, which belong to this sub-family, although most of them are usually referred to that universal denomination of *Pyrula*. The imperfectness of the specimens does not permit us to make alterations in those which have been described and figured; several of them will probably be found to belong to *Rapana* or *Tudicla* and allied genera of the *PURPURIDÆ*, others to *Neptunea*, *Polia* and other genera of the *FUSINÆ*.

It is equally difficult to say anything about *Perissolax*, Gabb (1861, Proc. Am. Phil. Soc. VIII, p. 122, and Pal. Calif. 1864, I, p. 91), which I think embraces a characteristic group of cretaceous shells (? the neogen *Fusus Burdigalensis*, Bast. and others) and may well stand in this sub-family. It is, however, very uncertain to state anything regarding *Pyrifusus*, Conrad (Jour. Acad. Phil. 2. ser. III, p. 332, Pl. 35, Fig. 12), and still more so as to the sub-generic name *Afer* (*ibid* p. 332, Pl. 35, Fig. 17,) of the same author; the first is actually quite uncertain, because the aperture is not known and the general form is common to a large number of other *MURICIDÆ*; the latter species (*F. bellaliratus*) does not seem to have any claim to be separated from *Fusus*, for it must first be proved, that the margins of the aperture were of the same kind as they are in *Fusus afer*, Reeve.

XXV. HEMIFUSUS, Swainson, 1840.

(COCHLIDIVM, Gray, 1847.)

This genus is separated from *Melongena* and *Fulgur* chiefly on account of the absence of the operculum; the species attributed to it have all a long thin canal, the posterior portion of the last whorl being ventricose, inflated and the spire very short. The whorls are deeply canaliculated below the suture, the keel being sharp and the transverse ribbing terminating on the same in points, bent upwards. There are several cretaceous species, described under *Fusus*, which exhibit the characters of this genus perfectly; others which agree in the general form of the shell only. Gabb noticed the first North-American forms under the sub-generic name of *Hemifusus*, and added lately several *characteristic* species in the Palæont. of California, Vol. I, p. 86. The *Strepsidula Ripleyana*, Conr. (Jour. Acad. Phil. 2nd. ser. IV, p. 286, Pl. 46, Fig. 42) belongs evidently to this genus.

I refer here two species to *Hemifusus*, both of which bear in general the characters of the living species, usually attributed to the same.

1. *HEMIFUSUS CINCTUS*, *Stoliczka*. Pl. X, Figs. 17 and 18.

Hemif. testa spira brevi, late conica; ultimo anfractu ad medium inflato, antice canali longo atque recto extenso; anfractibus senis, ad marginem suturalem tumescentibus, crenulatis, infra suturam excavatis atque infra excavationem angulatis, postea convexiusculis, transversim costatis; costis acutiusculis, antice in ultimo anfractu partim obsolete; superficie spiraliter striata, striis crassioribus atque tenuioribus alternantibus, antice aliquantisper sub-granulatis; apertura perlonga, postice latiori, antice versus sensim angustiore; labro acuto, intus sulcato; labio laevigato, tenui.

Spiral angle 80° ; sutural angle 6° .

Height of last whorl : total of shell (considered as 1.00) ... 0.73.

The principal characteristics of this species are the numerous transverse ribs, of which there are about twenty-two on the last whorl (their number being higher up nearly the same or somewhat less), the thick and obsoletely crenulated posterior margin of the whorls and the numerous spiral striæ, which cover the entire surface. These striæ usually alternate in strength on the last whorl and are on the excavated, posterior, portion generally somewhat thinner. The striæ of growth are very distinct on the well preserved surface of the shell, and form fine granulations on the spiral striæ. According to the elevation of the sutural margin and the posterior angle of the whorls the respective excavation between them is more or less deep, but it is always distinctly marked. The outer lip is sharpened and grooved internally, the inner lip near the posterior termination a little thickened, and the anterior canal long and straight.

When the surface of the shell is somewhat worn off the finer ornamentation disappears and the coarser spiral striæ appear more distant and sometimes granulated, as seen in Fig. 18, Pl. X; the posterior excavation becomes at the same time more obliterate.

This species so very much resembles in every way the *Voluta cincta*, Forbes, (Trans. Geol. Soc. Lond. VII, p. 132, Pl. 12, Fig. 6), that I am at a loss to give any strict distinctions between them. 'The number of longitudinal (here transverse) ribs and the strength of the spiral ones varying in almost every specimen,' says Prof. Forbes, and this is exactly what may be seen in our specimens. The spiral striæ, even when less numerous, are always stronger than in the following species, and the same is the case with the transverse ribs. The 'thickened crenulated rim' bordering the suture is equally well marked in both these similar species. Prof. Forbes states, however, distinctly, that the aperture is '4—5-plicata' and certainly he must have observed the plaits or something like them, and until this statement is disproved, or otherwise confirmed, the identification cannot be established. It is to be regretted that Prof. Forbes has not given a second view of the specimen, which he examined. He further states, that the species occurs also at Trichinopoly, which increases the difficulty, as I am unable to assign from our tolerably fair Trichinopoly collections any fossil really identical with that of Prof. Forbes. Certain it is, that in

any of our five specimens under examination, obtained from three different localities, there is not a trace of any plaits or folds on the columella, except a slight tooth-like thickening on the posterior termination of the inner lip.

Localities.—Kolakonuttom, Alundanapooram, between Andoor and Veraghoor.

Formation.—Trichinopoly group.

2. HEMIFUSUS ACUTICOSTATUS, *Stoliczka*. Pl. X, Fig. 19.

Hemif. testa spira brevi, anfractibus gradatis composita, suturis impressis junctis, infra suturam subcanaliculatis, angulatis, transversim acute costatis, spiraliter minutissime striatis; costis in ultimo anfractu duodenis, in anfractibus superioribus plus numerosis, omnibus ad angulum subspinosis.

Spiral angle 66° ; sutural angle 8° .

This species has the general characteristic form of others of the same genus, the whorls being contracted along the suture and the last much inflated, and—to all appearance—produced anteriorly into a straight canal, which unfortunately is not preserved in our single specimen. From the previous species, the *Hemifusus cinctus*, the present form differs remarkably by having the posterior portion of the whorl not so deeply excavated, the sutural margin being less thickened, the transverse ribs much smaller in number and thinner, and the spiral striæ only minutely marked. The spire appears to be also somewhat higher in proportion. The outer lip is quite sharp, sinuose, but not distinctly notched posteriorly; the inner lip is evidently very thin, without any posterior thickening.

Locality.—Near Comarapolliam in the Trichinopoly district.

Formation.—Arriallor group.

b. Sub-family—*FUSINÆ*.

The animals of the *FUSINÆ* have the head and tentacles moderately prolonged, the eyepeduncles thickened and usually for a short distance united with the former; they are mostly of a uniform red or olive colour; the operculum is ovate with an apical nucleus; the shell has the varices all of equal strength or they are obsolete; the canal is more or less prolonged, straight or slightly recurved.

Although numerous alterations have been made, since Lamarck first introduced stricter arrangements in the genus *Fusus*, the variety of shells at present admitted in this sub-family by the greater number of conchologists is still very great and can be classed only very gradually. There would probably not be any great difficulty in making at least two farther divisions, namely, shells with strong equal transverse varices and smooth or only striated shells; but such distinction could evidently be only of very limited value. The number and characteristics of the genera are far

from being settled; the following, of several of which representatives are to be found in the South Indian cretaceous rocks, are generally distinguished.

1. *Neptunea*, Bolten, 1798. (*Chrysodomus*, Swainson, Gray's Guide, 1857, p. 13. *Volutopsis*, Mörch or *Strombella* Gray, *ibid*, *vide* H. and A. Adams' Gen. II, p. 614.) Ventricose shells with short canal, often bent to the left and somewhat upwards; whorls convex, covered with a horny, rough epidermis, usually spirally striated, transverse varices obsolete, occasionally replaced by transverse ribbings, which are of about equal strength with the spiral ones.

The living species of *Neptunea* are coated with a thick epidermis and have a comparatively thin shell with obsolete transverse varices and a spiral striation only. The name ought to be retained for these forms only, and such species, quoted by H. and A. Adams under this genus, as *N. anomala*, *funiculata*, *fusoides* and others, have to be excluded and partially placed under *Tritonidea* and others.

Tertiary species, as *Fusus glomus* and *glomoides*, Gené, and several other forms have to be transferred to this genus, thus forming a very characteristic group of shells. Numerous cretaceous species belong also to it; (*vide* Proc. Am. Phil. Soc. 1861, VIII, p. 118; Pal. Calif. 1864, I, p. 88; Sitz. Akad. Wien. 1865, LII, Rev. etc. p. 77.)

We notice two species from South India, *Nept. rhomboidalis*, Zek. sp. formerly described as *Voluta id.* by Zekeli from the Alpine Gosau-deposits, and *N. excavata*, Blanf. sp., a remarkable form of the type of *Fusus corrugatus*, Reeve, and *F. glomus*, Gené, with a coarsely reticulated shell-surface.

2. *Euthria*, Gray—Adams' Gen. I, p. 86 — Spire about as high as the last whorl, conical; whorls smooth or spirally grooved, canal short, bent to the left (in front view) and somewhat recurved, aperture ovate, posteriorly subcanaliculated, inner lip smooth, outer lip sulcated internally. The shells are more consistent and thicker than in any *Fusus*. Gray (Guide, 1857, p. 43) calls *Euthria* a *Triton* with 'abortive or rudimentary varices'. The animal in form and colour resembles no doubt more the *TRITONIDÆ*, than the *FUSINÆ*, and if three lateral teeth can be proved to exist, the genus may perhaps be better transferred to the last family. I do not know whether all the ten living species attributed by Adams to this genus belong to it, some of them resemble (at least exteriorly) *Bullia* more. There are several tertiary species, which exhibit the characters of the genus very well, and of which *Nept. cornea*, Linn. is to be considered the type; but I am not acquainted with any cretaceous form exactly like; unless species such as *Neptunea curvirostris*, Gabb (Pal. Calif. I, p. 88, Pl. 18, Fig. 37), belong to it, which certainly does not appear very improbable.

3. *Clavella*, Swainson, 1835 (*Cyrtulus*, Hinds), buccinoid or fusiform shells, with accumulated spire and sub-cylindrical graduated whorls; surface smooth, spirally sulcated and occasionally with transverse varices, last whorl much thickened along the suture and somewhat contracted below it, forming an indistinct posterior canal on the aperture, anterior canal very short or prolonged in a straight line; on the termination only occasionally bent.

This type, which is well characterised by the cylindrical shape of the whorls, and the usual irregularity in the last of them, has not been as yet met with in the cretaceous strata, but it abounds in great variety in the eocene beds, decreases very considerably in the neogene, and only four species are quoted by Adams as living : All the fossil species have tolerably prolonged anterior canals, and it is not certain whether it would not be better to reserve the name *Clavellithes* of Swainson for the species with a very short canal and an excavated columella, as *Cl. avellana* and *distorta*. (vide *Polia*.) Species like *Cl. (Fusus) tuberculosa*, Desh. and *Cl. (Fusus) rugosa*, Lamck, form transitions to the next generic group, as restricted under the name. I do not think that there is any real necessity to separate *Thersitea*, Coquand, (*Géol. and Pal. de Const*, 1862, p. 267, Pl. XXIX, Figs. 30—33) from other *Clavellæ*, especially if the distinction between *Clavella* and *Clavellithes* be accepted.

4—*Fusus*, Klein, 1753.* Shell fusiform, elongated, last whorl—including the canal—shorter than the turreted spire ; canal more or less produced, at least equal to the height of the last whorl, straight, inner lip smooth, outer lip grooved internally, whorls spirally striated and ornamented with rudimentary uniform varices.

The greatest number of species of *Fusus*, as restricted, are living ; they are pretty numerous still in the neogene but much less so in the eocene strata, and of all the endless number of cretaceous *Fusus*, as known, only very few will be found to exhibit the characters of this genus sufficiently.

We have to notice only one species of *Fusus*, *F. verticillatus*, n. sp.

5—*Tritonidea*, Swainson, 1840. Shell ovate, buccinoid, last whorl sub-ventricose, canal short, or moderately prolonged, bent to the left, and on its termination recurved ; rudimentary varices numerous, all of equal strength, crossed by elevated thick spiral lines ; inner lip anteriorly thickened, smooth, posteriorly thin or cross-grooved, often toothed at the end ; outer lip thin, internally sulcated. H. and A. Adams consider this group only as a sub-genus of the next, but I think it ought to be kept distinct, if once a division of the old genus *Fusus* be acknowledged.

6—*Polia*, Gray, 1839. (*Cantharus*, Bolten, apud Adams.) Shell buccinoid, whorls convex with rudimentary and equally formed varices, and spiral elevated lines, last whorl ventricose, siphon *very* short and barely recurved ; mouth ovate, inner lip thin, cross-grooved in the entire extent, and posteriorly toothed ; outer lip thickened internally and denticulated.

Gray established this genus in the Zoology of Beechy's Voyage, p. 111, for a number of named and unnamed species, among the determinations of which he himself proposed afterwards great alterations ; but he does not seem to notice it at all in his Catalogue of 1857. Adams quotes only five species under *Polia* and 32 under *Tritonidea*, there cannot be however any doubt, that considerable changes must be

* The author's name designates (as in *Aporrhais*) only the first proposition of the name *Fusus*, although its characters were afterwards fixed by Bruguière, Lamarck, &c. and are still changing. It seems rather a mistake to substitute for such a universally acknowledged name as *Fusus* that of *Colus*, Humph., which, if it be correct, cannot have priority to that of Klein ; but it is still more inconsequent in Dr. Gray to use the name *Fusus*, Humph. in another place, designating by it *Rostellaria* of Lamarck.

made in these species. Several of them, as, for instance, *Neptunea anomala*, *funiculata*, *fusoides* and others (Adams. I, p. 80) must be referred to *Tritonidea*, and again species as *Cantharus* (*Tritonidea*) *biliratus*, *nigricostatus*, *pastinaca* and others (*ibid.*, p. 85,) must be transferred to *Hindsia* of the *TRITONIDÆ*.

Gray (Beechy's Voy., p. 112) quotes *Buccinum* (*Clavella*) *distortum* as a *Pollia*, and it is indeed remarkable the similarity which young specimens of this species have with *Pollia*, so that it may be after all proved, that the *Clavellæ* without a longer canal are only abnormally grown specimens of *Pollia*. If this could be proved the name *Clavellithes* must necessarily be avoided.

As indicated, there must certainly be great alterations introduced, if the two genera *Pollia* and *Tritonidea* are to stand, but the numerous fossil species seem fully to indicate and to justify such a separation. Several species of both genera are described by Deshayes, Hörnes and others under *Fusus* and *Murex* (*vide* Foss. de Paris, Pl. 76 and Wiener Moll. Pl. 25, respectively).

The cretaceous species belong chiefly to *Tritonidea*, and are more numerous than in any other genus of the *FUSINÆ*; they are in fact the predecessors of the *TRITONIDÆ* or rather perhaps of the *MURICINÆ*, and it is only questionable whether it would not be better to place them in the next sub-family. The form of the shell agrees better with the *MURICINÆ*, while the form of the aperture excludes them. Most of the *Fusus* described by D'Orbigny belong to *Tritonidea*, thus forming a transitional group between *Fusus* (as restricted) on the one, and *Murex* and *Hindsia* on the other side. Several other European cretaceous *FUSINÆ* have to be transferred to *Pollia* and *Tritonidea*, but scarcely any representatives of them are known from North America, at least none of the *Neptunea* or *Fusus*, lately described by Gabb, are so well marked as to be reasonably transferred to any of those genera. We shall describe from the South Indian cretaceous deposits four species under *Tritonidea*, namely, *T. gibbosa*, Stol., *T. Requieniana*, D'Orb., *T. granulata*, Stol., *T. Trichinopolitensis*, Forbes, sp. and one *Pollia*, *P. Pondicherriensis*, Forbes, sp.

Pisania (*Pusio*) and *Metula* appear to be better classed with the *COLUMBELLIDÆ* according to Gray.

I have thus given a review of the genera of the *FUSINÆ*, merely to shew what forms seem to be represented in the cretaceous formations, and how they may be traced. Were our fossil, mesozoic, materials usually better preserved, I have no doubt that several typical forms could be distinguished with generic names; and that in this way only can the daily doubts and objections as to species, which all are termed *Fusus*, be cleared up.

Pictet (Mat. Pal. Suisse, 3me. Ser. pt. II, pp. 642—650) enumerates 106 species of *Fusus* (= *FUSINÆ* and *FULGURINÆ*) from the cretaceous deposits of Europe only. There is not the slightest question, that not much more than half of these are true species properly belonging to this (and the former) sub-family, but it is difficult to say, when, or whether we shall ever come to such a knowledge of them as is desirable. It cannot be wondered at, that nearly every one, having procured a good

specimen, prefers giving it a new name, rather than identifying it with some uncertain cast, even when compared in original. A revision of the present species of cretaceous *Fusus* would be a tremendous work, although undoubtedly most important for the development and early study of the SIPHONOSTOMATA, but it could not be carried out without access to the original materials.

I have lately examined the Gosau species (Sitz. Akad. Wien, 1865, LII, Revis. etc. p. 81) and found, that of sixteen species described by Zekeli, only two could be retained, of which the *Fusus cingulatus*, Sow., is most probably not a *Fusus*, but a *Terebra* or *Bullia* or an allied genus; and the *Fusus Reussi*, Zek. may be proved to be a *Latirus*, as may also be expected with the *Fusus torosus*, which I added (l. c. p. 83) to the genus. (*Voluta torosa*, Zek.) We may have then out of sixteen cretaceous *Fusus* not one even of the sub-family *FUSINÆ*! certainly not one true *Fusus*; but this is surely not the case with other described species, at least not to that extent, and there are numerous *FUSINÆ* well known, as stated previously. The American species of *FUSINÆ* are between forty and fifty.

Forbes did not describe a single *Fusus* from South India, but numerous mistaken species have been attributed to him by subsequent correctors. I shall notice them briefly and append some remarks with regard to the alterations, which have been thought necessary.

1. *Voluta purpuriformis*, Forbes—*Fusus* id. D'Orb.—is *Athleta* id. (see *VOLUTINÆ* p. 91).

2. *Costellaria cancellata*, Forbes, loc. cit. p. 128 } = *Fusus subcancellatus*,
 „ *cancellifera*, *ibid*, Pl. 13, Fig. 18 }

D'Orb. could not be traced, but the fragment certainly belongs to an *Apporrhais* or *Alaria*, never to a *Fusus*, nor to any species of the *FUSINÆ*. It may be a fragmentary specimen of the upper whorls of *Ap. securifera*, Forbes (*vide* p. 28, Pl. II, Figs. 2—3).

3. *Phasianella incerta*, Forb. = *Fusus subincertus*, D'Orb. must provisionally remain as a *Phasianella*, as it is certainly not a *Fusus*, nor does it appear to belong even to that sub-family.

4. *Pyrula cancellata*, Sow. (apud Forbes) = *Fusus Forbesianus*, D'Orb. is a *Rapa*.

5. *Triton atavus*, Forb. = *Fusus* id., D'Orb., must remain as *Tritonium*.

6. *Murex fluctuosus*, Forbes = *Fusus* id. D'Orb., must remain as *Murex* provisionally (*vide* p. 129), until the species can be identified from better preserved specimens.

7. *Murex Pondicherriensis*, Forb. = *Fusus* id. D'Orb. is *Polia* id. *vide* p. 127.

8. *Voluta breviplicata*, Forb. = *Fusus* id. D'Orb. is *Cancellaria* (*Eucelia*) id. of *CANCELLARIIDÆ*.

9. The *Pyrula Pondicherriensis*, Forb., is identical with *Pyrula Carolina*, D'Orb., and has been described as *Ficulopsis Pondicherriensis* in the sub-family *VOLUTINÆ*: *vide* p. 85.

10. *Fusus ponderosus*, D'Orb. is *Athleta purpuriformis*, Forb. sp. (*vide* sub-fam. *VOLUTINÆ* p. 91).

11. *Fusus Fontanieri*, D'Orb., is *Rostellaria* (?) *palliata*, Forbes.

12. *Fusus buccinoides*, D'Orb. (Astrolabe, Pl. 7, Figs. 41 and 42) = *F. subbuccinoides*, D'Orb. (Prod. II, p. 229) I am unable to trace; it is possible that it belongs to *Neptunea excavata*, Blanf. sp. (*vide* p. 121), but as the sutural furrow is wanting in D'Orbigny's figure, the species must remain doubtful; it would, however, in all probability be classed under *Neptunea*.

After the exclusion of the doubtful forms we have then from the South Indian cretaceous rocks eight species of *FUSINÆ* described on the following pages under the generic names of *Neptunea*, *Fusus*, *Tritonidea* and *Polia*. I have already stated in my previous remarks the limits within which I believe these generic groups ought to be taken.

XXVI. NEPTUNEA, Bollen, 1798.

1. NEPTUNEA RHOMBOIDALIS, Zekeli, sp. Pl. X, Fig. 21.

1852. *Voluta rhomboidalis*, Zekeli, Abhandlungen d. Geol. Reichs-Anst. Wien, Vol. I. Pt. II. p. 80, Pl. 14, Fig. 9.

1865. *Neptunea id.* Zek. sp., Stoliczka in Sitzungsab. Akad. Wien. LII, Revis. etc. p. 78.

Nept. testa ovate-rhomboidali, anfractibus quinis, suturis impressis sejunctis, subplanis; ultimo maximo, spira longiore, subinflato; superficie in junioribus spiraliter numerosissime striata atque transversim costulata, in ætate proveciore striis costulisque plus minusve obsoletis; apertura elongata, utrinque acute terminante; marginibus arcuatis; labro acuto; canali producto, lateraliter curvo.

Spiral angle 66°; sutural angle 8°.

Height of last whorl : total of shell (considered as 1·00) ... 0·65

There has been only a single specimen of this species found in South India, and in comparing it with specimens from the Gosau-deposits, the differences are so slight that I cannot hesitate to identify it with the European fossil.

In my revision of the Gastropoda of the Gosau-formation (loc. cit.) I had already remarked, that the volutions ought to be a little narrower along the suture, than Zekeli's figure gives them, and that the canal is bent laterally. It may farther be noticed that Zekeli's enlarged figure 9' represents the species somewhat broader, the last whorl being more angulated about the middle, while it is more uniformly rounded in our figure. The reason for this is, that Zekeli's figure refers to a younger specimen, while ours is one of more advanced age, although it is, excepting the anterior termination of the canal, quite perfect as regards form. The ornamentation is not so distinct in our specimen, but this is more due to a deficient state of preservation of the surface, than perhaps to the larger size, although the transverse striæ become decidedly less strongly marked in advanced age, as I had occasion to observe

repeatedly on the Alpine specimens. The posterior margin of the whorls along the suture is generally somewhat more strongly marked, the last spiral furrow being usually deeper than the preceding.

Locality.—N. of Karapady in the Trichinopoly district; besides the Alpine Gosau-deposits, in the valley of the Gosau, I am not aware, that the species has been noticed from any other locality.

Formation.—Arriallor group.

2. NEPTUNEA EXCAVATA, *Blanford, sp.* Pl. XI, Figs. 1—3.

1862. *Fusus excavatus*, Blanford, Mem. Geo. Surv. India, IV, p. 118—name only.

Nept. testa ovata; anfractibus quinis seu senis, convexis, suturis profundis sejunctis, transversim atque spiraliter crassatim costulatis, in superficie cancellatis, atque subtuberculatis, prope suturam unisulcatis; ultimo anfractu spira longiore; apertura elongata, postice acute-angulata, subcanaliculata, antice effusa; labro margine undulato, intus sulcoso; labio moderato, postice paulum expanso, intus lævi, valde arcuato; canali lateraliter curvo.

Spiral angle 70° — 80° ; sutural angle 4° — 5° .

Height of last whorl : total of shell (consd. as 1.00) ... 0.65—0.70

The peculiar mode of ornamentation recalls very much the similarity of shells, which have folds on the inner lip and are consequently placed in the family *VOLUTIDÆ*, but there is not a trace of folds perceptible in the present species, and as the general form agrees with others of the same genus, we think it best to describe it under *Neptunea*. The form of the shell varies a good deal, some specimens being more inflated, short, and others having a more elongated spire, which however is always shorter than the last whorl. The ornamentation is equally very much subjected to variation; the normal state seems to be, when the transverse and spiral ribbings are about equal in strength, forming small nodules where they meet, and giving the surface a coarsely reticulated or cancellated appearance. The square fields between each four nodules are respectively deeply excavated, from which fact Mr. Blanford's name was derived. This regular mode of ornamentation, as seen partially in Fig. 1, is however not very often met with, chiefly from the commonly imperfect preservation of the shell-surface. Either the transverse, or more frequently the spiral ribs appear stronger, forming more or less isolated rows of tubercles, and in this way alter the appearance, as will be better seen by a comparison of our figures. The broad furrow along the suture is characteristic and is never wanting.

The margins of the aperture are somewhat dilated and thickened, being on the outer lip slightly undulated and interiorly grooved, while the inner lip is perfectly smooth. The canal is produced and bent laterally.

This species has, as regards the form of shell, the most striking resemblance to *Volutilithes limopsis*, Conrad (Journ. Am. Acad. Phil. IV, p. 292, Pl. 47, Fig. 24)

from the eocene rocks of Alabama, in which species Conrad records three plaits on the inner lip. There is no difficulty as to confounding specimens of this *Neptunea* with *Volut. radula*, Forbes, even when the plaits in the latter are not visible, as the spiral and transversal ribbings in this last named species are much more closely placed to each other and the square interspaces consequently much smaller.

Localities.—N. of Kunnanore and E. of Anapaudy, Serdamungalum, Kolakonnuttom, Shutanure, Andoor, E. of Veraghoor. The species is very common at the locality between the first two named places and not rare at the others.

Formations.—Trichinopoly and (?) Arrialoor groups. To the last group only the Veraghoor locality refers, according to Mr. Blanford's map.

XXIV. FUSUS, *Klein*, 1753.

1. FUSUS VERTICILLATUS, *Stoliczka*. Pl. X, Fig. 20.

Fus. testa elongata; anfractibus angulato-convexis, supra valde constrictis, transversim minutissime-, spiraliter crasse-striatis; striis spiralibus alternatim fortioribus, una ad medium anfractuum carinata, maxime elevata, obsolete tuberculata, secunda infra crassiore, atque ceteris in basi ultimi anfractus sensim tenuioribus, supra carinam striis senis, alternatim fortioribus, ornatis; labro ad marginem tenui, sulcato; labio tenuissimo; canali recto.

Spiral angle 46° ; sutural angle 11° .

This species is well characterized by its ornamentation, the transverse striæ of growth being only minute, although very distinct, while the spiral striation is much stronger. Each of the whorls is angulated in the middle by a sharp, obsoletely tuberculated carina, and above this there are, with the exception of the sutural margin, six striæ, alternately stronger and thinner; the second of the striæ below the carina is strongly marked on the last whorl and the following three become gradually thinner towards the anterior extremity, alternating regularly with others in strength. The striæ of growth are only very slightly elevated in crossing the spiral striæ and produce occasionally slight undulations of the latter. The inner lip is thin, the spiral striation being consequently partially apparent on the interior margin of the aperture; the canal quite straight; the outer lip sharp with an undulated margin, being slightly grooved internally.

Locality.—N. of Odium, in a brownish calcareous sandstone, very rare.

Formation.—Ootatloor group.

XXV. TRITONIDEA, Swainson, 1840.

1. TRITONIDEA GIBBOSA, Stoliczka. Pl. XI, Fig. 5.

Trit. testa elongata, ad medium gibbosa, utrinque acutiuscula; anfractibus octonis, primis duobus minutis, lævigatis atque politis; (in specimine cyaneo-coloratis), sequentibus convexis, prope suturam multo angustioribus, spiraliter dense striatis, infra transversaliter tuberculato-costatis; spira brevi, acuta; ultimo anfractu latissimo, gibboso, costis ad medium convexitatis crassis, tuberculosi, striis suprà et prope suturam tenuioribus; canali spiræ sub-æquali, paulum lateraliter atque supra recurvo; labio antice calloso, postice tenui; labro aculo, margine undulato, intus sulcoso.

Angle of the spire (excepting the last whorl) 35° ; sutural angle 6° .

Height of last whorl : total of shell (consd. as 1.00) ... 0.63.

The great number of whorls, being strongly contracted on the suture and the last being more than twice as wide as the penultimate, but rapidly narrowing on the anterior extremity again, give this shell a very characteristic form, which, combined with the ornamentation and the shortness of the canal, recalls very much the similarity of some species of the family *TRITONIDÆ*.

The figured specimen is in excellent preservation, and on this the two uppermost whorls are perfectly smooth with a blueish tinge; it is probable that this colouring is original on the shell. The whorls next to the embryonal are only spirally striated, and the transverse ribs do not appear until on the third before last, being obsolete near the suture, where the spiral striæ are considerably thinner. On the last whorl they may be said to form transversally elongated tubercles, ten in number. The spiral striæ are strongest in crossing these tubercle-like ribs, and become towards the anterior extremity broader, but less elevated, and gradually obsolete. The striæ of growth are distinctly perceptible, but very fine.

The aperture is somewhat pear-shaped, broadest above and gradually narrowing and lengthened anteriorly. The outer lip is sharp, internally grooved; the inner lip quite smooth, posteriorly thin, anteriorly somewhat thickened; the canal is laterally curved with its termination somewhat turned upwards. Near this termination the inner lip is somewhat thicker, forming a very slight fissure exactly similar to the largest number of living *Tritonideæ*.

This species bears evidently considerable resemblance to *Fusus Marrotianus*, D'Orb. (Pal. Franç. terr. crét. Pl. 225, Fig. 2), as regards general form and spiral striation, but the smaller number of whorls with a somewhat more obtuse spiral angle and the few transverse ribs on each of them appear to justify fully the proposed distinction of the two species. J. Müller (Petref. d. Aachener Kreidef. 1851, p. 34) unites the *F. Marrotianus*, D'Orb. with *F. Clementinus* of the same author. The forms of both and our own species are like enough, but as D'Orbigny's figure of the last-named species represents only a very poorly preserved cast, the question cannot be settled satisfactorily without the original specimens.

Locality.—N. of Alundanapooram in the Trichinopoly district; very rare.

Formation.—Trichinopoly group.

2. TRITONIDEA REQUIENIANA, D'Orbigny, *sp.* Pl. XI, Figs. 8 and 9.1842. *Fusus Requierianus*, D'Orbigny, Pal. Franç. Terr. crét. p. 342, Pl. 225, Fig. 3.1851. „ *Buchi*, Müller, Petrefacten der Aachner Kreideform. p. 35, Pl. V, Fig. 15.

Trit. testæ elongata, spira acuta; anfractibus circiter septenis, convexis, superioribus cancellatis, ceteris crasse spiraliter striatis transversimque costatis; costis 10—12 in uno circuitu, ad medium maxime elevatis, antice in ultimo anfractu obsolete, postice tenuioribus, usque ad suturam prolongatis; striis crassis minutissimis alternantibus; ultimo anfractu maximo, gibboso; canali lateraliter atque supra recurvo; labio tenuissimo.

Spiral angle 55°—65°; sutural angle 8°.

The shell consists of four—seven convex volutions, the spire, when well preserved, being of about the same length as the last of them. Each of the whorls of the spire is ornamented by ten—twelve transverse ribs and about five spiral striæ. The two uppermost (posterior) of these striæ are placed somewhat closer to each other and are thinner than the following. When the shell-surface is well preserved a very fine spiral striation is perceptible between each of the stronger striæ. The anterior portion of the last volution is striated similarly to the rest of the shell, but the transverse ribs disappear perfectly on it. All the whorls are posteriorly somewhat more contracted than anteriorly; the ribs are slightly curved, reaching from one suture to the other, being, however, posteriorly considerably thinner, while the spiral striæ increase a little in thickness, where they cross the transverse ribs.

There exists scarcely any difference, that we could record between our specimen, represented in figure 9a and D'Orbigny's figure. The uppermost whorls are in our specimen corroded, and on that account only the spire appears to be somewhat shorter. There are ten transverse ribs on each volution in D'Orbigny's specimen, while there are twelve in ours; this number appears to change, however, often in one and the same specimen.

It seems very desirable to compare specimens of *Fusus Itierianus*, D'Orb. (loc. cit. Pl. 223, Fig. 2) with those of the present species, for both the figures of D'Orbigny are remarkably alike. The only perceptible distinction is, that the whorls are posteriorly somewhat less contracted in the former, but the difference does not seem to exceed the limits observed in our materials. The fine striation between the coarser in *F. Itierianus* cannot be looked upon as a character of specific difference, for it depends merely upon the state of preservation. I have placed the *Fusus Buchi*, Müller, as a synonym of *F. Requierianus*, although Dr. Müller says that it differs in every way from it. Comparing however the description and figure of the former the only difference which can be noted is a somewhat larger number of whorls and of transverse ribs; in both these points the identity is perfect with our smaller specimen represented in Fig. 8, Pl. XI. The real fact appears to be, that the uppermost whorls are gradually worn off with the advanced age of the specimen. The variation in the number of transverse ribs has already been noted, and that they appear a little sharper, is a matter which may reasonably be expected in younger specimens.

D'Orbigny described his *Fusus Requienianus* first from the chloritic beds of Uchaux and transferred it in his Prodrôme to the 'Turonien.' The *Fusus Buchi* of Müller occurs in the 'Grünsand' (about equivalent to the upper Greensand of English geologists) of Aachen (Aix-la-Chapelle). In general the species may be regarded as a middle cretaceous fossil.

Localities.—East of Anapady in a soft chloritic rock and near Veraghoor in a whitish sandstone, in Trichinopoly district; rare.

Formation.—Trichinopoly group.

3. TRITONIDEA GRANULATA, *Stoliczka*. Pl. XI, Figs. 6 and 7.

Trit. testa ovalo-conica; anfractibus subconvexis, posterius ad suturam margine tumescente atque una serie granorum ornatis, infra marginem profunde canaliculatis, infra canalem costis crassis transversalibus atque striis spiralibus ornatis; costis circiter denis in uno circuitu, rectis, tuberculato-elongatis, antice evanescentibus; striis plus minusve granulosis, in anfractibus spiræ ternis seu quaternis, in ultimo numerosis; canali anteriori elongato, prope recto.

Spiral angle 55°; sutural angle 10°.

This species is referred to *Tritonidea*, chiefly on account of its general resemblance to other species; no specimen has been observed with the anterior portion of the canal perfectly preserved. In general form and partly in the ornamentation, the present species resembles much the *Trit. Requieniana*. The specific distinctions are, however, pretty clearly marked, for not only the single whorls are less convex, but the entire ornamentation differs in its greater details. The posterior margin along the suture is much thickened, ornamented with a row of numerous spinose tubercles; below it there is a strong constriction like a canal, on which the transverse ribs terminate. The number of the granules on the sutural margin is much larger than the number of transverse ribs, so that the former cannot be regarded as the upper terminations of the latter. All the stronger spiral striæ are more or less granulated and form pretty sharp tubercles in crossing the transverse ribs. There are, at least in young specimens, very fine intermediate striæ to be observed between the stronger ones, of which three or four are present on the upper whorl. The uppermost of these latter is somewhat thinner than the lower three.

The inner lip is distinctly striated, but on the anterior portion apparently thicker, than in *Polia Pondicherriensis*; the outer lip is internally grooved. The last whorl is somewhat higher than the spire, and the anterior canal is for the greater portion of its length almost straight.

Locality.—S. E. of Parchair in the Trichinopoly district, apparently very rare.

Formation.—Trichinopoly group.

4. TRITONIDEA TRICHINOPOLITENSIS, *Forbes, sp.* Pl. XI, Fig. 4.1846. *Murex Trichinopolitensis*, Forbes, Trans. Geol. Soc. Lond. VII, p. 127, pl. 15, fig. 7.„ *idem* D'Orbigny; Gabb; Pictet; &c.

Trit. testa elongata, ad medium inflata, utrinque attenuata; anfractibus senis primis lævigatis, ceteris costate-cingulatis, transversim costatis, ad medium angulatis; supra angulum duobus striis fortioribus atque multis minoribus ornatis, costis sub-obsoletis; apud et infra angulum crasse tri-cingulatis, in interstitiis etiam multi-striatis; costis transversis rectis, ad angulum nonnunquam tuberculis seu spinulosis; ultimo anfractu antice canali moderato protracto, valde constricto; labio intus lævigato, postice tenui, antice incrassato; labro ad marginem intus sulcoso; canali ad terminationem lateraliter atque supra recurvo.

Spiral angle 65°; sutural angle 8°—9°.

Height of last whorl : total of shell (considered as 1·00) ... 0·60—0·65.

Between the principal spiral striæ there is always a dense and fine striation perceptible, and some of these secondary striæ vary again in strength. On the upper flat portion of each whorl there are only two stronger striæ and on the lower (on the last whorl the middle) straight portion three, respectively much thicker, and the uppermost occasionally forming rounded tubercles on the edges of the transverse ribs. These latter become obsolete on the posterior portion of each whorl as well as on the anterior portion of the last. The striæ of growth are very distinct and produce occasionally with the finer striation a kind of minute granulation. The canal is only slightly bent laterally, but it is more strongly bent upwards than in any of the other species, and on its termination it appears to be also somewhat widened. The inner lip thickens somewhat towards the anterior extremity. The only known species which it would seem very desirable to compare with the Indian fossil, is *Fusus Nereidis*, Münst. (in Goldf. Petref. Germ. III, 1841-1844, p. 24, Pl. 171, Fig. 20). A perceptible difference, judging from Goldfuss' figure only, lies in the spiral striation, although this could be easily explained from the state of preservation. Münster's species appears to be pretty common in the middle cretaceous deposits of Germany; (*vide* Zeitsch. Deutsch. Geol. Gesell. XV, p. 340).

Localities.—N. of Alundanapooram and S. of Olapaudy; appears to be a rare shell.

Formation.—Trichinopoly group.

XXVI. POLLIA, *Gray*, 1839.1. POLLIA PONDICHERRIENSIS, *Forbes*, *sp.* Pl. XI, Figs. 10—12.1846. *Murex Pondicherriensis* Forbes, Trans. Geol. Soc. Lond. VII, p. 127, Pl. 13, Fig. 20.1850. *Fusus* „ D'Orbigny, Prod. II; *idem*, Gabb; Pictet; and others.

Pol. testa ovata, apice acuta; ultimo anfractu maxime inflato; anfractibus circiter septenis, convexis, supra angustioribus, planiusculis, transversim 12—16-costatis, spiraliter costato-striatis; striis crassis in costis transversalibus fortioribus, nonnunquam subtuberculosis, una seu duabus minoribus, filiformibus, alternantibus; apertura ovali; labro ad marginem intus sulcoso; labio tenui; canali brevissimo (?).

Spiral angle 60° — 68° ; sutural angle 6° .

Height of last whorl : total of shell (considered as 1.00) 0.61—0.62.

Width of „ „ : its height („ „) 0.92.

All the whorls are much more strongly contracted above than below and somewhat flattened, while the lower portion is strongly convex. The transverse ribs, which vary between 12 and 16 in number, are posteriorly thinner, but can be generally traced up to the suture. Besides the sutural line there are usually on the flattened portion of the whorl three striæ, the middle one being the strongest, and three others, respectively much stronger than the previous, are placed on the lower portion. As the size of the shell increases, thinner striæ appear gradually between the principal ones, but there are very rarely more than two of them between two of the former. When the shell surface is well preserved the striæ of growth are found to produce on the spiral striation a fine granulation, otherwise they appear somewhat distinct only in the interstices.

The aperture is ovate; the outer lip on its margin internally sulcated; the inner lip not much thickened and partially crenulated and striated. The canal was certainly short, and although it has not been observed with its termination perfect in any of our numerous specimens, it could scarcely differ in form very much from that of living species of the same genus, as may be seen in the restored Fig. 10 or 11, Pl. XI. I may remark here, that this specimen is very nearly perfect, and that only a portion of the margin of the outer lip is broken away, the impressions of the interior sulcation being well preserved. The ornamentation not being otherwise unlike, I have long been in doubt whether it would not be more appropriate to refer this species to *Phos*, Montfort, but the want of a separate anterior fold on the inner lip and the comparatively great thickness and solidity of the shell agrees undoubtedly better with living species of *Pollia*.

Prof. Forbes described this species as *Murex*, pointing out distinctly the shortness of the anterior canal, and there does not appear much reason to support D'Orbigny's views in transferring the species to *Fusus*, from which *Pollia* as at present accepted must be kept totally distinct, intermediate between the subfamilies *MURICINÆ* and *FUSINÆ*.

Localities.—Alundanapooram, neighbourhood of Anapady and Veraghoor, in the Trichinopoly district; a tolerably common shell.

Formation.—Trichinopoly group.

c. *Sub-family*,—*MURICINÆ*. (Adams, Chenu, Gray and others.)

The animals of the *MURICINÆ* are almost exactly like those of the *FUSINÆ*, at least they do not exhibit any greater variations, except that the margins of the mantle are generally more developed and form usually at an interval of one-third of each revolution stronger spinose or lamellar varices in the former sub-family. The aperture of the shell is round, internally smooth and only the margin of the outer lip often undulated; in a great number of species the canal is externally, up to a narrow open line, closed; the operculum is ovate with a sub-apical nucleus.

It is certainly necessary to divide this family into at least four genera (or rather five) as proposed by Dr. Gray (Guide, 1857, p. 11) and others.

1. *Murex*, Linn. 1758, restricted to the species with a short spire, ventricose, strongly convex whorls, thick varices with or without single spines, and a long canal.

The *M. spirilla*=? *Tudicla* of Adams and Chenu excluded.

2. *Chicoreus*, Montfort, 1810, with three principal and more or less sub-equal spinose and lamellarly branching varices, last whorl usually somewhat higher than the spire, canal short with its termination bent to the right.

2a. *Pteronotus*, Swains. 1840.—Of the other sub-genera, quoted by Adams, this ought I believe to be established as a genus, comprising chiefly elongated shells with the spire about the same height as the last whorl or even somewhat higher, each whorl ornamented with three laterally much compressed, fin-shaped varices; secondary varices more or less obsolete, the interspaces being often quite smooth, the canal of moderate length, externally usually perfectly closed by the extended margins of the aperture, the termination straight or only very slightly bent. There are a considerable number of tertiary fossil species, which indicate this separation as very desirable.

3. *Typhis*, Montf. 1810, characterized *especially* by the tubular canal near the posterior edge of the mantle; includes a large number of typical shells.

4. *Trophon*, Montf. 1810.—The varices are numerous, lamellar, single and equally formed, posteriorly angulated, prolonged into short lamelliform spines, hollowed out internally; the anterior canal is open, of moderate length and usually bent to the left (in the frontal view of the shell).

The sub-family, as at present restricted, forms a very well defined, natural group of shells, and each of the genera, as here stated, have numerous representatives in neogene and eocene beds. By much less certain, however, is any knowledge of the cretaceous species, attributed to this same group of shells. The following cretaceous species have been recorded by Pictet (Pal. Suisse, 3me Ser. p. II, p. 660); *M. Prestensis*, P. et Camp; *M. Genevensis* P. et R.; *M. carinella*,

Sabaudianus et *bilineatus*; P. et Camp; *M. calcar*, Sow.; *M. pleurotomoides*, Müller. In my revision of the Gosau-Gastropoda (Sitz. Akad. Wien, 1865, LII, p. 80), I have mentioned as doubtful *M. loricatus* (*Tritonium* id. Zek.); and I actually do not know where the two last named species could be better placed, although they have no intermediate stronger but all very sharp varices, as most of the species of *Chicoreus* have, to which genus alone they can form additions. The six first named species may belong to the same group, but they are not so perfectly known as to admit of their difference from *Polia* and *Tritonidea* of the *FUSINÆ* being positively stated. All this is to be looked for with better materials, and the generic denomination of *Murex* shows in general only, that the species most probably belong to the *MURICINÆ*. Of the three species noted by Prof. Forbes as *Murex* I have referred the *M. Pondicherriensis* to *Polia* and *M. Trichinopolitensis* to *Tritonidea* of the *FUSINÆ*, but I am not able to trace *M. fluctuosus*, nor could I pronounce an opinion on its generic denomination. The species may prove to belong to this or to the former sub-family; it ought provisionally to stand here, as no reason can be given for its being shifted about into other groups.

Gabb lately described a very interesting species, *Typhis antiquus*, from the cretaceous rocks of California (Pal. of California, 1864, I, p. 82, Pl. 18, Fig. 31.); it is the first representant of the genus in cretaceous beds. We notice from South India another equally remarkable species belonging to the sub-family *MURICINÆ* and in all probability to the genus,

XXVII. TROPHON, Montfort, 1810.

1. TROPHON OLDHAMIANUM, Stoliczka. Pl. XI, Fig. 13.

Troph. testa elongata, fusiformi; anfractibus gradatis, supra valde-excavatis, ad marginem suturalem subinflatis, infra planiusculis, spiraliter crasse striatis, transversim lamellose costulatis; costulis supra in excavatione obliquis, ad angulum spinulosus, infra rectis, in striis spiralibus lamellose-elevatis, plus minusve muricatis; labio lævigato, tenui; apertura?—canali?—

Spiral angle 44° ; sutural angle 9° .

This very characteristic fossil agrees in every respect so entirely with living species of the genus *Trophon*, that there can be little doubt as to its being a representative of this group in the cretaceous deposits.

All the whorls are along the suture deeply and broadly excavated, below nearly flattened ornamented with coarse spiral striæ, which are usually unequal in strength, numerous on the last whorl, while only three remain visible on the previous, and gradually disappear towards the uppermost. The margin of the suture is somewhat swollen up; on the excavated portion below no spiral striation is visible, but the oblique transverse ribs, which are nearly straight on the lower portion, are here lamellar and more or less elevated into spines on crossing the spiral striæ, especially so on the angle, which bounds the excavation below.

The specimen under description is rather imperfect, neither the apex nor the aperture is preserved, but the very characteristic ornamentation may for the present serve as a sufficient distinction. The inner lip is thin and smooth; near the suture the shell is remarkably solid.

Locality.—S. of Serdamungalum in Trichinopoly district; apparently very rare; only the figured specimen has been examined.

Formation.—Trichinopoly group.

XI. *Family*.—TRITONIIDÆ.

Animal with a thickened, truncate head; tentacles of moderate length, with the eyes on the external thickened basis, or within the first half of their length; proboscis long, retractile; lingual membrane, with teeth in seven rows, the lateral in three series each; mantle enclosed; siphon usually produced and nearly straight; foot always expanded, with thin margins, truncate anteriorly.

Operculum ovate, lamellar, of the same size as, or occasionally smaller than, the aperture, and with an apical or lateral nucleus.

The shells are more or less ovate, usually thick and consistent, covered with a rough, horny epidermis; the whorls ornamented in the course of growth with permanent apertural varices, of which at least the last one is always distinguished, even when all the previous become obsolete; the surface is usually roughly covered with spiral striae and more or less spinose tubercles; the aperture is ovate and both lips usually denticulated or sulcated; the inner lip has often posteriorly an elongated tooth so as to narrow by it the aperture; the canal is more or less produced.

The genera usually admitted in this family are *Ranella* (*Bursa*, Adams, *Apollon*, Gray) *Persona* (*Distortio*, Adams), and *Tritonium*, of the first and last of which H. and A. Adams quote a number of sub-genera. Gray restricted the name *Ranella* for *B. crumena* (and ?), as distinguished by a semiovate operculum, with a centro-lateral nucleus, and places it in the *CASSINIDÆ* (Guide, 1857, p. 39). If this be admitted, *Persona* in having a similar operculum and differing far more in the constitution of the shell must be separated from the *TRITONIIDÆ* also. There does not seem any particular necessity for either change, as otherwise nearly the entire family must be disbanded.

A generic distinction of those species, as *B. crumena*, within the family *TRITONIIDÆ*, appears quite sufficient. It cannot be questioned that the present distinction, as accepted between *Ranella* and *Tritonium*, based principally upon the number of varices in one whorl, is very uncertain. When Philippi searched anxiously after other distinctive characters between *Ranella* and *Tritonium*, it shows only that he had carefully observed a number of one and the same species in different stages of growth. For if any body has had the opportunity of examining a really large number of these living shells on the sea-coast, he will easily be convinced, that he could make a good number of species of *Tritonium* and *Ranella*

too out of one series of shells, of which the animals are evidently perfectly the same as regards any specific distinctions. All that appears likely is, that any classification depending upon the existence of two varices in one, or three in two whorls, must be given up as of principal importance, and that a number of genera ought then to be framed according to the general form and a summary of other distinctive marks, as has been partially proposed by H. and A. Adams. It must be granted that the varices are in many species scrupulously constant in their position, and that they will always form good marks of distinction, but certainly they are not so to the extent of forming strict generic separations. So long, however, as only specimens of 'distinguished beauty' are recorded and represented in our collections, it is indeed a difficult task to entertain hopes, that any one will succeed in a generic arrangement of the family. The following would perhaps summarise the present state of our knowledge.

1.—*Ranella*; as in Gray's Guide, 1857, p. 39; the examination of the opercula only can fix any certainty of distinction from

2.—*Lampas*; ovate shells, with distinct and open posterior canal, very short anterior canal like *Tritonium lampas*, *Ranella foliata*, and others (*Aspa*, Adams, included).

3.—*Apollon*; produced anterior canal; last whorl ventricose; outer lip much thickened on the margin; no, or at least not an open, posterior canal, with two varices on each whorl; species like *Ranella gigantea*, *gyrinus*, and others.

4.—*Eupleura*; as stated by Adams, Genera, I, p. 107.

5.—*Persona*; (*Distortio*, Adams, Gen. I, p. 104.)

6.—*Simplum*; shell ovate; whorls nodulose; last ventricose; canal distinct, more or less produced; margins of aperture strongly thickened; outer lip exteriorly bounded by a varix, internally thick, dentate; posterior canal indicated, not open. Under this name could probably be better included the species quoted by Adams in the sub-genera *Simplum*, *Cabestana*, *Lottorium*, and *Gutturnium*, *Tritonium* and *Clandestinum*, Chem, and others. The distinction from *Apollon* would be based simply upon the number of tubercles within restricted limits. Imperfect specimens will be difficult to separate from *Tritonium*, although from the nature of the outer lip the varices ought to be always much stronger.

7.—*Epidromus*; vide Adams' Gen. I, p. 103, probably not excluding *Ranella anceps*.

8.—*Tritonium*,* as restricted (Adams' Gen. I, p. 102), ovately elongated, canal short; outer lip thickened in front, somewhat reflected with sharpened outer edge; inner lip thin, posteriorly more or less expanded, and near the posterior angle of the aperture with a fold-like tooth;—*Ranella candidata* probably included.

9.—*Lagena*; shell thin, more like that in *Neptunea*; whorls roundish or angulated with short transverse ribs, and mostly obsolete varices; margins of the aperture continuous; inner lip with a fold-like tooth posteriorly; outer lip internally

* In a case so easily remedied as this, I do not see the advantage of supposing, that the meaning applied to a word by any one should be misunderstood as applying to a reptile, where he is only speaking of a shell.

smooth with broad sulci; externally inflated forming a varix, but not much thickened; canal usually somewhat produced; columella solid. This genus ought to be certainly distinguished from *Tritonium* and the other genera, being well characterized by the thinness of the shell as compared with other *TRITONIDÆ*. We noticed the same difference, accompanied with other distinctive characters (as stated), on two species from the South Indian cretaceous rocks, the description of which will be found more in detail farther on under this generic heading. Chenu entertains, as I believe justly, some doubts as to the species attributed by Adams to this genus.

If the *Trit. Tranquebaricum*, Linn., be not separated from *Simplum*, there is certainly no reason to do so with *Tr. clandestinum*, Lamk. for both have the characteristic form and thickened outer lip of *Simplum*, except that the varices become on the upper volutions more or less obsolete. There is usually only one varix on the last, and sometimes one, two, or three preceding ones well developed on the previous volutions, but I do not think that there is any great necessity for separating these forms from *Simplum*, save on account of the few differences in the structure of the shell; certainly they are not to be united with *Trit. cancellatum*, Lamk., *T. Oregonense*, Say, *T. Chemnitzii*, Gray, and others in one genus. The *Trit. (Buccinum) gluciale*, Müller, ought, I believe, to be placed here and not under *Buccinum*.

10.—*Argobuccinum* (vide Adams' Gen. I, p. 104). This genus would seem to differ only by the more solid structure of the shell, and by the outer lip being internally thickened and dentate, the canal short, recurved; it could be retained for *Tr. scabrum*, King, *Ranella Argus*, Lamk., *R. vexillum*, Sow., and a few tertiary fossil species. The *Trit. rude*, Brod., appears rather to be a *Polia*.

11.—*Hindsia*,* Adams, 1850; (*Nassaria* in Adams' Gen. I, p. 123; *Hindsia* of Chenu). Excepting the last varix on the margin of the outer lip, there is no other one distinguished from its size, although the whorls are transversally numerously ribbed; the canal is produced and recurved; the aperture roundish; the inner lip transversally grooved, and the outer lip internally thickened and dentate. These characters distinguish the shells of this genus easily from *Lagena* and *Argobuccinum*.

Gray (Guide, 1857, p. 43) does not seem to be inclined to separate these forms from *Tritonium* (*Triton*) at all; and Adams, Chenu, and others placed the genus under the *BUCCINIDÆ*, next to *Phos*, Montf. H. and A. Adams refer (loc. cit. p. 127) to some distinctions in the animals between *Nassaria* and *Tritonium*, but certainly on comparing these with the animals of most of the *BUCCINIDÆ*, it may be seen that the dilated foot, the placing of the eyes, and the straight siphon are far more like in the *TRITONIDÆ* than is generally the case in species of the *BUCCINIDÆ*. The shell from its consistency and ornamentation is decidedly that of a *Tritonium* and

* Mörch (Proceed. Zool. Soc. Lond., 1862, p. 227) says 'the first species is *Nassa lyrata*, Gmel., p. 3794; Mart. IV, Figs. 1122-1123. If the quotation of Gmelin is right, the type is *Mangelia*; but if Martinis' figures are correct, the type is *Bucc. niveum*, Gmel. The latter, however, is not probable; and therefore the name *Nassaria* must not be used for *Hindsia*, H. and A. Adams.'

not of a *Buccinum*, or even *Phos*; and the same applies to the form of the operculum. *Hindsia*, or *Nassaria*, as stated by Adams, forms a small group of very characteristic shells, to which, however, species as *Canth. biliratus*, *pastinaca*, *nigricostatus*, and a few others classed by Adams under *Tritonidea* (Gen. I, p. 85), ought to be added. On the whole, I believe that it is absolutely necessary to form a generic distinction for these shells, but not to separate them from the other *TRITONIDÆ*. For the study of the fossil species this genus is very important; there are numerous shells belonging to it described from tertiary beds under *Murex* and *Fusus*, and some of the cretaceous species of *Tritonium* and others appear to belong also to it, as I shall presently mention more in detail.

The fossil forms of the family *TRITONIDÆ* do not seem to exhibit any marked generic distinctions from the living, at least I am not acquainted with a single one which would necessitate the formation of a separate group or even a sub-genus. It is therefore easier to classify the recent shells, as the state of preservation cannot here interfere. The present difficulty in coming to a conclusive arrangement is only the want of specimens in different stages of growth, as is especially required in *Tritonium* and *Apollon*.

The tertiary species belong mostly to *Lampas*, *Apollon*, *Simplum*, and a few cocene to *Epidromus*. The number of these tertiary species is comparatively a large one. Of cretaceous species only a few are recorded, but the state of preservation scarcely allows of a very close determination.

1.—*Tritonium urgonense*, Pictet et Camp. (Mat. p. l. Pal. Suisse, 3me. ser., 2me. pte. p. 662, Pl. 96, Fig. 3, and p. 663), would appear to belong to *Tritonium* (as restricted). Pictet compares its generic identity with *Tritonium fusiforme*, Kiener, which, at least in its predominant characters, belongs to this genus.

2.—*Tritonium cretaceum*, Müller (Pet. Aach. Kreidef., 1851, II, p. 47, Pl. 5, Fig. 2). Although Müller (p. 48) says that the species occurs 'in best preservation' in the 'Grünsand' near Vaelsbrug, the representation which he gives certainly does not appear to be that of a perfectly preserved specimen. In no other genus, save *Epidromus*, do the varices appear so oblique as to cross the other transverse ribs, and the species if perfect can therefore only belong to this; otherwise any body might be misled to see in it only the upper portion of the shell of a species of the *ALATA*.

3.—*Tritonium Konincki*, Binkh. (Gast. et Ceph. Limbourg, 1861, I, p. 4, Pl. 1, Fig. 10) has externally the varices not well distinguished, and from the impressions of teeth on the inner margin of the outer lip it would appear to be a *Tritonium*.

4.—*Tritonium Gosauicum*, Zekeli, 1852 (*vide* Sitz. Akad. Wien, 1865, LII, Revs. etc. p. 80, Pl. 1, Fig. 4), is a *Simplum*, known from the aperture in good preservation.

5–8.—*Tritonium Hornii*, *Diegoensis*, *paucivaricatum* and *Whitneyi* have been described by Gabb from the cretaceous beds of California (Pal. 1864, I, pp. 94–96). None of the species was found with the aperture well preserved; the three first named would seem to be *Tritonium* proper, although the shells in general very much resemble some species of *Leiodomus*, Swainson, which with *Adinus* of Adams are

quoted by H. and A. Adams (Gen. I, p. 114) as sub-genera of *Pseudostrombus*, Klein (*Dorsanum*, Gray). It is by no means certain that these two generic groups do not belong to the *TRITONIIDÆ*. I should say, judging from figures only, that the ornamentation and the form of the aperture would rather be in favor of such a transfer. The last of Gabb's species may be possibly a *Hindsia*, if not a *Tritonidea* of the *FUSINÆ*.

9-12.—*Tritonium gravidum*, *Lagena nodulosa* and *secans*, and *Hindsia eximia* are four species from the South Indian cretaceous rocks. The descriptions of these are given below.

To these have to be added probably the following :—

Triton atavus, Forbes (Trans. Geol. Soc. Lond. VII, p. 126, Pl. 13, Fig. 14). I have not been able to trace this species, and until other specimens have been procured, Forbes' name must be retained. Certainly the species is not a *Fusus*, to which all subsequent writers following D'Orbigny refer the same, but in all probability is a true *Tritonium*.

Triton? elegans, Desh. (Mem. Soc. Géol. France, 1842, V., pt. I, p. 14, Pl. 17, Fig. 13, *Fusus id.* D'Orb.) is probably a *Hindsia*, so far at least as the exterior character of ornamentation is concerned, and very much the same appears to be the case with

Fusus Gaultinus, D'Orbigny (Pal. Franç. Crét. II, p. 335, Pl. 223, Fig. 1); *Fusus Vibrayeanus*, D'Orb. (*ibid.* Pl. 223, Fig. 6); *Buccinum cancellatum*, Alth. (Haidinger's Abhandlungen, 1850, III, p. 224, Pl. 11, Fig. 25), from the cretaceous deposits near Lemberg in Galizia; and *Fusus pedernalis*, Römer (Kreidebildg. Texas, 1852, p. 38, Pl. 4, Fig. 13), will probably be shown to belong to *Hindsia* also. The figured specimens seem to have been all in tolerably good preservation, and the point of difference could be very easily settled by an inspection of the originals.

The following so called species have to be excluded from the family *TRITONIIDÆ*: *Tritonium crebriforme*, Zek. (*vide* Stoliczka in Sitz. Akad. Wien, 1865, LII, Revis. p. 80) being only a fragmentary specimen of a *Cerithium*; *Tritonium loricatum*, Zek. (Gosau Gasterop. 1852, p. 83, Pl. 15, Fig. 3; Stoliczka, loc. cit. p. 80). This species has been transferred by me to *Murex*, and as the specimen figured by Zekeli is a perfect one, it appears tolerably certain that the species belongs at least to the sub-family *MURICINÆ*, although it is difficult to determine the genus strictly. Were the outer lip thickened by a varix, it might be justly referred to *Hindsia*, but in such a case the single known specimen could be only in a transitory state of growth.

Summarizing the above notes we may say, that there are at present 12 species of cretaceous *TRITONIIDÆ* known as certain, divided into equal numbers of four, from Europe, from North America, and from India. Five species more, *viz.*, three from Europe, one from North America, and one from India, are somewhat doubtful, but most probably belong to this family. Of all the species yet found in the cretaceous deposit, not one belongs to the forms commonly known under the generic name

of *Ranella*, and only one belongs to *Simplum*, another perhaps to *Epidromus*, and the rest either to *Tritonium* or *Hindsia*, both genera respectively fewer in number as represented among living shells.

XXXI. HINDSIA, *Adams*, 1850.

1. HINDSIA EXIMIA, *Stoliczka*. Pl. XI, Figs. 15—17.

Hinds. testa ovate elongata; spira ultimo anfractui æquali seu paulum breviori; anfractibus senis, convexis, primis duobus lævigatis mamillatisque, ceteris transversim costatis, spiraliter costulato-striatis; costis 10-12 in uno circuitu, parum curvatis, æqualibus; striis fortioribus, in ultimo numerosis, omninis in costis transversalibus subtuberculatis atque in interstitiis una vel duabus striis tenuioribus ornatis; apertura rotundata, antice elongata; marginibus intus crenulatis; labro incrassato, variciformi; canali moderate prolongato, lateraliter atque supra recurvo; basi antice obsolete-fissurata.

Spiral angle 60°-70°; sutural angle 6°.

Height of last whorl : total of shell (considered as 1·00) ... 0·63—0·52.

The height of the spire is somewhat variable; being in some specimens, which are more inflated, somewhat shorter than, in others about equal to, the height of the last volution. The ornamentation is very characteristic, and in no way different from that in living species of the same genus. The whorls are more contracted above or posteriorly than below, and are crossed by 10 to 12 equally strong, transverse ribs, and usually four or five strong spiral striæ, which on reaching the former are elevated into more or less sharpened tubercles. The two uppermost striæ are with respect to the others a little thinner, the next lower somewhat more elevated than the following two, in addition to which occasionally a sixth one is apparent on the suture of the penultimate whorl. On the last volution these stronger striæ are by far more numerous, covering the entire anterior portion, and between all of them there appear gradually, with the growth of the shell, one or two finer striæ.

The aperture is roundish, and anteriorly narrowly prolonged with the margins all round crenulated or obsoletely plicated. The outer lip is thickened, forming exteriorly a thick varix; the inner lip is also thickened, leaving a slight fissure visible near the anterior extremity; this latter is recurved laterally, and somewhat upwards, the margin of the inner lip, where the columella terminates, is as usual sharp.

In the specimens figured on Pl. XI it will be observed that the small tubercles on the transverse ribs become fully developed only after the specimen reached a certain size. In this stage of growth the species recalls very much the ornamentation of *Fusus Gaultinus*, D'Orb. (figured Pal. Franç. Crét. Pl. 223, Fig. 1, by mistake under the name of *F. rusticus*, Fitton). In young specimens of *H. eximia* the spiral striæ are, however, more uniform in thickness, and more closely placed to each other; at the same time the finer intermediate striæ are almost totally wanting.

Localities.—Comarapolliam, Arrialoor and near Vylapaudy, in the Trichinopoly district; not common.

Formation.—Arrialoor group.

XXXII.. TRITONIUM, *Link*, 1807.1. TRITONIUM GRAVIDUM, *Stoliczka*. Pl. XI, Fig. 14.

Trit. testa ovale elongata, turrita; anfractibus septenis, ad suturas planiusculis, et angustatis, supra medium angulatis, infra lente convexis, transversim obstulatis, spiraliter striatis, costulis atque striis supra medium multo tenuioribus; margine suturali posteriori tumescente et obsolete crenulato; infra medium striis spiralibus ternis fortioribus atque in costis transversalibus spinulose tuberculatis conspicuis, numerosis minoribus striis alternantibus; varicibus crassis, posterius spinose angulatis, in circuitu anfractuum $\frac{2}{3}$ distantibus; apertura subrotundata; labro extus moderate crasso, intus ad marginem sulcoso; labio lamelliformi, lævigato, postice unidentato, medio arcuato, antice crenulato; canali brevi, lateraliter curvo; columella ad terminationem anteriorem obsolete fissurata.

Spiral angle 65° ; sutural angle 6° .

Height of last whorl : total of shell (considered as 1.00) ... 0.52.

An ovate shell consisting of about seven volutions, the last of which is very nearly of the same height as the spire. Each of the whorls is posteriorly much narrower and flattened, angulated a little above the middle and then slightly convex. The posterior edge along the suture is somewhat thickened and obsoletely granulated. The transverse ribs are from 14 to 16 in number in each volution, but they are very variable in strength in the different specimens; on the flattened portion of the whorls they always become thinner, although they never seem to disappear totally. The anterior portion of each of the upper whorls is ornamented with usually three strong spiral striæ, which, in crossing the transverse ribs, form small spinulose tuberculations. On the last whorl these spiral striæ are of course much more numerous, and the transverse ribs become towards the anterior extremity only very gradually obsolete. The interstices between the stronger striæ and all the flattened posterior or upper part of the whorls is covered densely with a much finer striation. The varices are very distinctly marked, often ornamented with sharpened tubercles, and distant from each other two-thirds of the circuit of each whorl. The aperture is roundish; the outer lip thickened externally and grooved internally; the inner lip provided posteriorly with a prolonged tooth, in the middle smooth and anteriorly partially crenulated; it is rather thin, lamellar, as is usually the case in typical *Tritonium*, not so enormously thickened as in *Simplum*. The canal is short and slightly bent to one side and a little upwards. The anterior margin of the inner lip being somewhat raised above the surface a slight fissure is formed on the columella.

Our Indian fossil recalls, as regards the general character or ornamentation, the *Tritonium Urganense*, Pict. et Camp. (Mater. p. l. Pal. Suisse, 3me. ser. p. 662, Pl. 96, Fig. 3), which, although determined from a much smaller and imperfect specimen, differs evidently by the coarser and less numerous transverse ribs, and by having four stronger spiral striæ on each of the upper whorls. It belongs, however, most probably to the same group of the *TRITONIDÆ*.

Locality.—From a light coloured sandstone S. of Arrialoor; rare.

Formation.—Arrialoor group.

XXXIII. LAGENA, *Klein*, 1753.

I am not acquainted with any known cretaceous species, which could be properly attributed to this genus; and those two noted here from the South Indian cretaceous deposits stand, as regards their specific characters, almost perfectly isolated among cretaceous fossils.

1. LAGENA NODULOSA, *Stoliczka*. Pl. XI, Fig. 18.

Lag. testa ovate elongata, tenui; anfractibus quinis, primis mamillatis lævigatisque, ceteris ad medium acute-angulatis atque nodulosis, ultimo inflato tricarinato, carina superiori subnodulosa, carinis duabus inferioribus sublævigatis, tenuioribus; superficie spiraliter striata; apertura late angulata; labio lævi, postice plicose-dentato; labro extus varicoso, intus late sulcoso; canali lateraliter moderate curvo.

Spiral angle 65°; sutural angle 10°.

Height of last whorl including the canal : total of shell (considered as 1·00) ... 0·64.

In general form this species recalls very much *Tritonidea* and similar *FUSINÆ*, but the large varix, which forms the outer lip of the aperture, indicates immediately its great relationship to other *TRITONIDÆ*. The shell consists usually of about five volutions, the embryonal of which are smooth and somewhat enlarged. The spire is only a little shorter than the height of the last volution. The posterior portion of the upper whorls is much contracted, either flat or somewhat excavated and separated from the anterior perpendicular half of the whorls by a sharp numerously tuberculated keel. The tubercles are depressed both above and below, and their number amounts on the preceding whorl to about 12; often it is rather less than more. On the last whorl two additional keels appear below the principal one, but they do not usually exhibit any tuberculation.

The entire surface of the shell is besides covered with fine striæ of growth and a dense spiral striation, among which generally only one line below the tuberculated keel predominates a little in strength.

The aperture is much enlarged, angular with sharp raised margins, and internally quite smooth, with the exception of an elongated tooth on the posterior portion of the inner lip. The canal seems to be somewhat more elongated than usual in living species of this genus, and is bent slightly towards the left side (in front view).

Localities.—Near Shutanure, Veraghoor, Vylapaudy and Arrialoor, in the Trichinopoly District; not common.

Formations.—Trichinopoly and Arrialoor-groups; to the latter the two last mentioned localities refer. The specimens from the two series of beds are all exactly alike, and offer no object of remark.

2. *LAGENA SECANS*, *Stoliczka*. Pl. XI, Fig. 19.

Lag. testa ovate elongata, turrita, tenui; anfractibus ad medium acutissime carinatis, ultimo bicarinato; superficie spiraliter striata; apertura?—labio laevi; postice plicose dentato.

Spiral angle 55°; sutural angle 6°—7°.

This species, although not very rare, has not yet been procured in a desirable state of preservation, but its similarity to the preceding cannot leave a single doubt that it belongs to the same genus; in both, the structure of the shell is exactly alike.

It differs from *L. nodulosa* in having the keel of the upper whorls sharper, devoid of any distinct tuberculations, and only one additional keel on the last whorl. The outer joins the inner lip on the upper keel, while in *L. nodulosa* the aperture does not reach higher than to the median keel. The shell surface exhibits no farther ornamentation than a fine spiral striation and equally fine striæ of growth. Fragments of the upper whorls of specimens with not well preserved shell surface are much like *Trichotropis (Turbo) Konincki*, Müll. sp.

Localities.—Olapaudy, W. of Arrialoor, and S. W. of Mulloor, in the Trichinopoly district.

Formation.—Arrialoor group.

XII. *Family*,—*COLUMBELLIDÆ*.

This family embraces a small number of genera, which agree in the *ovate or elongated form of a rather solid shell, a very short anterior canal, often replaced by an emargination of the anterior extremity only, and crenulated or plaited margins of the aperture, which is very often much narrowed by the thickening of the lips, specially of the outer one.*

Dr. F. Rolle published in 1861 some very able notes (Sitzungsb. Akad. Wien., Vol. XLII, p. 261, &c.) on the different types of *Columbella* (*sensu Lamarcki*) which occur living and neogene, being represented in the cretaceous period by *Columbellina*, D'Orb. and in the upper jurassic strata by the genus *Columbellaria*, Rolle (the typical species being *Col. corallina*, Quenst. sp., *Cassis* idem, Quenst.); it will be sufficient to refer here to these valuable observations. The living *Columbellæ* have been divided by Bellardi and others into different sections, according to the varying form of the shells. Gray, Adams and others accept a certain number of genera and sub-genera, and there can be no question that this system ought to be carried out; but great difference of opinion still exists as to the limits of these divisions, and they ought to be brought probably more into accordance with the apparently artificial classification of Bellardi. It does not seem likely that any other separation will practically succeed, than one based chiefly on the principal variations in the form of the shell, otherwise we must still increase the number of the sub-genera, which are quoted by Chenu and others. No less difference

exists as to the classification of the family *COLUMBELLIDÆ* among the PROSOBRANCHIA. H. and A. Adams admit it as a sub-family of the *MITRIDÆ*, but for this the constitution of the shell does not seem to give any support. (*Vide* our family *VOLUTIDÆ*, p. 75). Gray places it next to *Nassa* in the *MURICIDÆ* only on account of having the nucleus of the operculum apical, while his *BUCCINIDÆ* have the same lateral. The animals of the *COLUMBELLIDÆ* are rather more like those of *Eburna* and *Cominella* than of *Buccinum*, but they have, on the other hand, nearly as much resemblance to those of *Persicula* and other *MARGINELLIDÆ*.

Deshayes classifies, as I have already stated, *Columbella* in the family *VOLUTIDÆ*, for which I do not see a sufficient reason. It is well known that a number of the living species described by different authors as *Columbella* belong properly to the *MITRIDÆ* or *PURPURINÆ* (*Ricinula*), and when all these have been separated the family will form a pretty well characterised group. It appears, therefore, to us most advisable to regard, with Chenu, the *COLUMBELLIDÆ* as a separate family, and I place it here because the fossil forms indicate evidently a transition between the *MURICIDÆ* and *TRITONIIDÆ* on one and the *BUCCINIDÆ* and *PURPURIDÆ* on the other side. The few known cretaceous species of the family belong without exception to

XXXIV. COLUMBELLINA, D'Orbigny, 1843.

Through the long posterior canal the cretaceous forms are most nearly allied to some tropical living forms, as *C. mercatoria*, *harpæformis* and others. Pictet (Pal. Suisse. Foss. Ste. Croix, p. 671) enumerates seven species; of these the two Indian *Pugnellus* must be excluded (*vide* our family *ALATA*, p. 18), and we notice in their place another species, which appears to be a true *Columbellina*. The specimen, which was found in the Ootatoor group near Odium, is as yet unique, and is represented in Fig. 1 on Pl. XII. It being impossible to form the slightest conjecture as to the details of ornamentation of the shell surface, we prefer not to name this cast specifically. There do not seem to have been any strong ribs or tubercles present, because there is no trace of them left on the cast, but still, the shell having been evidently very thick, its surface may have been very richly ornamented. The anterior and posterior canals and the dentition on the middle parts of the outer and inner lips, as well as the interior shape of the aperture, are very distinctly marked.

The great interest which is attached to the Indian species is its occurrence among the few as yet known GASTROPODA from the Ootatoor group, and I would therefore direct the special attention of any subsequent visitor to those places to this interesting fossil.

The number of known *COLUMBELLINÆ* from cretaceous beds is therefore to be reduced to six species, if actually the *Col. brevis*, P. and C. and *Col. neocomiensis*, D'Orb. sp. are different, and if the Indian species is distinct from those already known; its form recalls no doubt strongly that of *Col. monodactylus*, Desh. sp., but until the shell surface of the former is known, no support whatever can be given to these suggestions.

XIII. *Family*,—*BUCCINIDÆ*.

BUCCINIDÆ and *CYCLOPSIDÆ*, Chenu; *BUCCININÆ* and *NASSINÆ* of *BUCCINIDÆ*, H. and A. Adams; *COMINELLINA*, *NASSINA*, *PHOSINA* of *MURICIDÆ* and *BUCCININÆ* of *BUCCINIDÆ*, Gray).

In the separation of the *BUCCINIDÆ* from the *PURPURIDÆ* we intend to follow Chenu, but we do not think that there exists any necessity to distinguish the *CYCLOPSIDÆ*, certainly not as an independent family, for there is actually not the slightest reason to be found in support of a separation of *Cyclops*, Montf., from the *NASSINÆ*, as I will mention subsequently.

The animals of the *BUCCINIDÆ* have a distinct, truncate head, the tentacles of moderate length, with the eyes on their outer side sessile: the eye-peduncles being represented only by small bulgings, or somewhat produced and united with the tentacles; the proboscis usually long; the teeth in three series, the central being broad and fixed, the lateral versatile; mantle enclosed; siphon usually recurved; foot simple, truncate in front, laterally waved and posteriorly always terminating in one or two points more or less produced.

The operculum is annular, but varying in size, form, and the place of its nucleus, according to the different sub-families.

The shells are mostly conically ovate, to a great extent smooth, and, if the whorls are ribbed transversally, the ribs are never unequal in strength; the canal is either very short or in most cases reduced to a deep notch, and the inner lip of the aperture is either smooth or dentate on the inner projecting margin only, but never folded.

According to the different prevalent shapes of the shell and the form of the operculum, four sub-families were distinguished, especially by Gray. With regard to their relations to the *TRITONIDÆ* and *COLUMBELLIDÆ* on the one side, and the *PURPURIDÆ* on the other, they may be quoted as follows:—

a. *Sub-family*—*PHOSINÆ* (Gray, Guide, 1857, p. 17).

- Genera; 1. *Phos*, Montfort., 1810.
 2. *Northia*, Gray, 1847.
 3. *Cyllene*, Gray, 1833.

b. *Sub-family*—*NASSINÆ* (Gray, l. c. p. 16).

- Genera; 1. *Desmoulea*, Gray, 1847.
 2. *Cyclops*, Montf., 1810 (*Neritula* apud Adams, l. cit. p. 122).
 3. *Nassa*, Lamarck, 1799.
 4. *Bullia*, Gray, 1835, probably including *Pseudostrombus*, Adams, but excluding *Leiodomus* (in parte) and *Adinus*, forming separate genera, either here or in the *TRITONIDÆ*. *Buccinanops*, D'Orb., could be retained as a good genus.

Chenu (Man. I, p. 164) formed for *Cyclops*, Montf. and *Teinostoma*, H. and A. Adams (Genera, I, p. 122), a separate family, *CYCLOPSIDÆ*, which certainly must be

cancelled.* Gray (Guide, 1857, p. 17) does not separate *Cyclops* from *Nassa* at all, while other writers think the *Cy. neriteus* is only an abnormal form of some other species of *Nassa*. Chenu obtained a new species of *Cyclops* from the Crimean sea, *Cy. kamiesch* (vide Manucl, p. 165), which in general form agrees with the other Mediterranean species, but neither the animal nor the operculum has been made known of this second species. Comparing the animal of *Cyclops neriteus* with that of *Nassa*, it must be agreed that they are, strictly speaking, perfectly identical, and that the opercula of both are very similar, or at least not more different than in other forms of the so-called sub-genera of *Nassa*. The only difference exists in the form of the shell, and in comparing this, for instance, with species of the sub-genus *Auricularia* (Adams' Gen. I, p. 118), we meet forms evidently indicating a passage to *Cyclops*, differing from it almost solely by the short transverse ribblings. It appears quite sufficient to retain *Cyclops* as generically distinct from *Nassa*, but at the same time certainly to retain both in one sub-family. Fossil species, like *Nassa gibbosula* and a few others of upper tertiary age, belong to *Cyclops*. *Teinostoma*, Adams (Gen. II, p. 615), is justly referred to the *ROTELLIDÆ* of Gray (*UMBONINÆ*, Adams), and I believe the jurassic fossil species like *Trochus Moreanus*, D'Orb., or the species of *Helicocryptus* are most nearly related to it. The family *ROTELLIDÆ* has many more fossil than recent representatives, and some of the oldest known Gastropoda belong to it, but they are as yet dispersed under all the genera of *TROCHIDÆ*; only comparatively few have been described as *Rotellæ*, some even as *Delphinulæ*.

Regarding the numerous sub-genera of *Nassa* quoted by Adams, it is difficult to form an idea as to their relative value, and so long as they are not supported by the examination of the respective animals, they must be looked upon merely as convenient sections or divisions of *Nassa*. It must, however, be granted that forms like *Zaphon* (= ? *Aciculina*, H. and A. Adams, 1853, non *id.* Deshayes, 1864), *Uzita*, *Naythia*, and others ought to be generically separated, although it will be difficult to follow these and other divisions in fossil Conchology, but probably only because the number of the fossil species as yet known is comparatively very small. The jurassic genus *Purpurina*, D'Orb., is generally referred by French authors to the family *BUCCINIDÆ*, but there is not much support to be found for this classification in the formation of the shell. We shall mention the genus again in the family *TRICHOTROPIDÆ*.

c. Sub-family.—*COMINELLINÆ* (Gray, Guide, 1857, p. 15).

- Genera; 1. *Cominella*, Gray, 1847.
 2. *Truncaria*, Adams and Reeve, 1848.
 3. *Eburna*, Lamarck, 1801.

* Chenu, as seen from several other instances, does not appear to have noticed Adams' Appendix, pp. 614-648, at the end of the IInd Volume. There are several very important and valuable additions and corrections to be found in it.

d. Sub-family—*BUCCININÆ*, Gray (loc. cit. p. 21).

Genera; 1. *Buccinum*,* Linn., 1767.

2. *Pseudoliva*, Swains. 1840 (*Gastridium*, Sow.; *Gastridia*, in Gray's Guide; *Sulcobuccinum*, D'Orb., 1850, Prod. II, p. 303).

The shells of fossil and recent *Pseudolivæ* agree in general form rather more with *Buccinum* than with *Purpura*, with the latter of which the genus has been associated by H. and A. Adams and Chenu.

3. *Buccinopsis*, Conrad, 1857, and

4. *Pseudobuccinum*, Meek and Hayden, 1857.

These two genera are founded upon two species from the cretaceous beds of North America, and they appear to resemble in general form *Buccinum* and *Pseudoliva*.

5. *Haydenia*, Gabb, 1864 (Pal. Calif. I, p. 98), is allied to *Pseudoliva*, and probably best classed here. Its general form and anterior canal recall some species of the *PURPURIDÆ*.

Species which can with sufficient certainty be said to belong to the family *BUCCINIDÆ* are not known from any beds lower than the jurassic, if we refer to it the *Buccinum? oolithicum*, Heb. and Desl. (Bull. Soc. Linnè. Norm. 1860, V, p. 173, Pl. VII, Fig. 14) from Montreuil-Bellay. The species appears to belong to the *PHOSINÆ* or *NASSINÆ*, although there are no living forms known, which have the anterior termination of the aperture and the last whorl so much produced and so slightly notched. It could quite as well form the type of a new genus.

The *Buc. bidentatum*, Buvignier (Stat. de la Meuse, p. 45, Pl. 29, Figs. 14—16) from the coral-rag can be quite as well a species of the *CERITHIIDÆ* or *LITTORINIDÆ*.

The *Buc. angulatum*, Sow. (Trans. Geol. Soc. Lond., ser. II, Vol. IV, p. 347, Pl. XXIII, Fig. 5) from the Portland-stone belongs to the family *ALATA* (*Aporrhais* or *Alaria*), and the *Buc. naticoide*, Sow. (*ibid* Fig. 4) is said to be a *Natica*. The shell has very much the form of a *Pterodonta*. The *Buc. parvulum*, Röm., is perhaps identical with *Orthostoma Virdunensis* Buvign. (Stat. Meuse, Pl. XXXII Fig. 7), but the species looks rather more like a *Purpurina*.

Bucc. lævigatum, Piette, (Bull. Soc. Géol. France, 1856, XIII, p. 595, Pl. XV, Figs. 19 and 20) appears to be a true *Nassa*, or one of the sub-genera. The *Bucc. oliva*, Piette (*ibid* Figs. 17 and 18) is rather more like an incomplete *Cylindrites*, for when the outer lip in any of these forms is broken away, the anterior extremity seems to have terminated in a canal, while in reality this appearance is only caused by the twisted columella or the plaits on it, and the aperture has in its perfect state only the anterior portion of the lip somewhat produced, but not notched.

Cretaceous species are also very limited in number. From the eocene beds about 30 species are known up to the present, which number increases in the neogene period to about four times as many, and again trebles itself in the present time, as there are about 360 living species of *BUCCINIDÆ* known. Since the

* For several species, described by Reeve under *Buccinum*, as *B. cassidariaforme*, *B. signum*, and others. A. Adams proposes a new generic name *Siphonalia*, vide Ann. Mag. nat. hist. 1863, XI, p. 202; the shells are stated to have no epidermis, a short, recurved anterior canal, and are otherwise allied to *Neptunea*; the operculum is like that of the *FUSINÆ*.

restriction of the genera it has been found, that the smallest number of fossil species belong to *Buccinum* proper. There is scarcely one true *Buccinum* from the cretaceous beds, to which genus in general the species have been attributed. (*Vide* Mat. p. l. Pal. Suisse, 3me. ser. pt. ii, pp. 672 and 673). The following are the cretaceous species known up to the present time; most of them belong either to the sub-family *NASSINÆ* or *BUCCININÆ* :—

1. *Buccinum gaultinum*, D' Orb., is most probably a *Nassa*.
2. „ *rennense*, D' Arch., in all respects a very doubtful species.
3. „ *Steiningeri*, Müller, a *Nassa*.
4. „ *constrictum*, Hall and Meek, sp. (*Fusus id.* Am. Acad. Arts and Sc. Boston, v, p. 391, Pl. 3, Fig. 7) may be a *Nassa*.
- 5.—*Pseudobuccinum Nebrascense*, M. and H. (1857. Proc. Acad. Nat. Sc. Phil. p. 140).
- 6.—*Buccinopsis Parryi*, Conrad, 1857, Emory's Report, p. 158, Pl. 3, Fig. 4. I have not been as yet able to procure this publication, and quote the species on Mr. Gabb's authority (*vide* Proc. Am. Phil. Soc. VIII, 1861, p. 97).
- 7.—*Nassa lineata*, Sow., 1836 (*Buccinum pseudolineatum*, D' Orb.) is a true *Nassa*.
- 8.—*Buccinum supracretaceum*, Binkh., 1861 (Monogr. Gast. et. Ceph. de Limbourg, p. 12, Pl. 1, Fig. 7) is apparently a *Nassa*, and related to *Nassa Arrialoorensis*, n. sp.
- 9.—*Buccinum liratulum*, Gabb, 1864 (Pal. Calif. I, p. 26, Pl. 28, Fig. 211). The posterior lip is rather thickened, and it is possible that the species belongs to *Bullia*.
- 10-11.—*Nassa cretacea* and *antiquata*, Gabb, *ibid*, p. 97.
- 12.—*Haydenia impressa*, Gabb, *ibid* p. 98.
- 13-14.—*Pseudoliva lineata* and *volutiformis*, Gabb, *ibid*, p. 99.

To this we add from the South Indian cretaceous deposits three new species,

- 15-17.—*Nassa Vylapaudensis* and *Arrialoorensis*, and *Pseudoliva subcostata*.

To the species of *Buccinum*, quoted by Pictet and Campiche, as to be excluded, we would add, *Buc. cancellatum*, Alth, which appears to be a *Hindsia* (*vide* ante p. 10).

Nassa affinis, Sow., is not a *Cerithium*, as D'Orbigny suspected, but a *Rissoa* and remains *R. affinis* = *R. velata*, Zek.; *vide* Sitz. Akad. Wien, 1865, LII, Revis. etc., p. 19.

Nassa carinata, Sow.; it is not possible to trace this species without comparing the original fragment, although it most probably belongs to *Pterocera subtilis*, Zek. (Sitzungsab. Akad. Wien, 1865, LII, Revis. etc., p. 70).

Nassa costellata, Sow.; (Fitton in Trans. Geol. Soc. London., ser. II, Vol. IV, p. 344, Pl. XVIII, Fig. 26). D'Orbigny (Prod. II, p. 156) places this species under *Cerithium*, and apparently more correctly, for the remaining varices on the whorls, to which Sowerby refers in his description and figure, are quite foreign to species of the *BUCCINIDÆ*, but they do occur often among the *CERITHIIDÆ*, and especially among cretaceous forms, as *Cerithium reticosum*, Sow., *Cerith. furcatum*, Zek. and others.

Excluding thus the very doubtful species we may say, that there are up to the present 17 species of *BUCCINIDÆ* known from cretaceous rocks, five being European, nine North American, and three South Indian; but I suspect that, when all the forms described from the cretaceous beds of Europe under the name of *Cerithium* are better known, several species of *NASSINÆ* and *PHOSINÆ* will be found represented among them. The comparatively large number of North American species has increased only through the late addition of the successful Survey of California, and the careful examination of the fossils by W. Gabb. The three Indian species are noticed here for the first time, thus adding to the six or seven species of *Nassa* two more, and to the two North American species of *Pseudoliva* one. Compared with other fossils as regards their frequency of occurrence, the *BUCCINIDÆ* must be said to be very rare, and most of the species are known from single or a few specimens only.

XXXV. NASSA, Lamarck, 1799.

1. NASSA VYLAPAUDENSIS, Stoliczka. Pl. XII, Fig. 4.

N. testa conica, spira elongata; anfractibus senis seu septenis, prope planis, suturis parum impressis sejunctis, transversim costulatis, in parte posteriori apud suturam 4-5 striis spiralibus ornatis; costulis obliquis, paulo arcuatis, interstitiis latioribus separatis, circiter 20 in uno circuitu; ultimo anfractu ad basim subangulato; basi spiraliter dense striata; apertura—?

Spiral angle 40° ; sutural angle 8° .

Although the aperture is not quite perfectly preserved in any of our specimens, the general form of this shell is so characteristic, that it most probably belongs to this genus. It is most nearly allied to those species, which H. and A. Adams refer to the sub-genera *Zeuxis* and *Zaphon*.

The shell is conical, composed of six or seven nearly flat volutions, each of them being crossed by about 20 transverse ribs. These are slightly curved, oblique, and below the suture traversed by four or five spiral striæ, becoming gradually thinner as the distance from the sutural line increases. The base of the last volution is densely covered with spiral striæ also. The aperture has been restored in its probable shape from a second but otherwise more defective specimen. The columellar lip appears to have been partially thin, as the spiral striation is traceable on the posterior portion quite clearly, but the columella itself was quite solid.

This species bears a great resemblance to several tertiary forms of *Nassa*, but there is up to the present no cretaceous species known, which could be compared with our Indian fossil.

Locality.—Vylapaudy in Trichinopoly; four specimens have been examined.

Formation.—Arrialoore group.

2. NASSA ARRIALOORENSIS, Stoliczka. Pl. XII, Fig. 3.

N. testa conico-elongata; anfractibus senis, convexis, suturis profundis sejunctis; singulis postice ad suturam valde constrictis, spiraliter dense striatis, transversim costatis; costis circiter denis in uno circuitu, obliquis, crassis, ad suturam abrupte tenuioribus atque subangulatis, antice in ultimo anfractu evanescentibus; apertura ovali; labio lævi, crasso, calloso.

Spiral angle about 40° ; sutural angle 11° .

It is with some doubt that I refer this species to *Nassa*, although it may belong to the section *Uzita* of Adams, as the edge of the columella along the canal is somewhat sharpened, not provided, however, with a fold. The great thickness of the inner lip, which is smooth internally, and the general form of the shell, makes it almost certain that the species has to be classed with the *Buccinidæ*. The only almost exceptional case, which could be expected when perfectly well preserved specimens of

this species are procured is, that the posterior constriction of the whorls along the suture may be connected with, and dependent on a slight insinuation of the outer lip, and in such a case the species would have to be transferred to *Mangelia* or *Clathurella* (*Defrancia*, Millet). I have not, however, been able to detect in our present specimens any curvation of the striæ of growth, which would indicate such a notch on the aperture. The spiral striæ are fine and cover the entire surface of the shell; their slight undulations are caused by the striæ of growth.

Buccinum supracretaceum, Binkhorst, quoted above, is the nearest and among cretaceous species the only ally of our Indian fossil. It differs, according to Binkhorst's figure, by the more uniform convexity of the whorls and by the transverse ribs being almost perpendicular to the direction of the sutural line.

Localities.—Vaitagoody and N. of Karapady, in Trichinopoly district. Only two specimens have as yet been examined; neither of them has the outer lip, nor the anterior extremity with the termination of the canal, perfectly preserved.

Formation.—Arrialore group.

XXXVI. PSEUDOLIVA, Swainson, 1840.

1. PSEUDOLIVA SUBCOSTATA, Stoliczka. Pl. XII, Fig. 2.

Pseudol. testa ovata; spira ultimo anfractu brevior; anfractibus quinque, primis duobus lævigatis, ceteris transversim multicostatis; costis circiter 16 in uno circuitu, parum obliquis, in ultimo anfractu infra medium evanescentibus; parte anteriori ultimi anfractus usque ad sulcum medianum spiraliter striata; sutura canaliculata; margine posteriori anfractuum terminatione costarum coronato; apertura ovali, postice acuta; labio lævi, calloso, arcuato.

Spiral angle 65°; sutural angle, 10°.

This pretty little shell is, although not perfectly preserved, well characterized by the numerous transverse ribs, which on the last whorl become obsolete about the middle of its height; they are slightly curved, and on the deeply canaliculated suture somewhat produced into sharpened points. Below the principal furrow, which is characteristic for the genus *Pseudoliva*, the anterior portion of the last whorl is finely, spirally striated, the rest of the surface being apparently smooth. The posterior part of the inner lip is thickened, and so far as visible internally quite smooth; the canal or rather the emargination of the anterior extremity is indicated by a slight swelling extending from the inner margin in a curve parallel to the principal furrow; the termination of the canal has not been, however, as yet observed.

Locality.—Ninnyoor; occurring in a white arenaceous limestone; only the figured specimen has as yet been procured.

Formation.—Arrialore group.

XIV. *Family*.—*PURPURIDÆ*.

The animals of the *PURPURIDÆ* are in general much like those of the *Buccinidæ* except that the foot does not terminate posteriorly in a separate process, and is in general stouter and more truncate; the tentacles are never very long, and the eye-pedicles unite with them, terminating at half the length of the former. The operculum is oblong, with an elongated nucleus at the *outer edge*.

The shell of the *PURPURIDÆ* is usually distinguished by the shortness of the spire and large size of the last whorl, being anteriorly either notched or produced into a canal; the inner lip is smooth, occasionally toothed posteriorly and anteriorly; it is always *somewhat flattened*, where the columella terminates, forming inside a more or less distinct edge. According to Gray (Guide, 1857, pp. 18—21) two sub-families may be easily separated, *PURPURINÆ* and *RAPANINÆ*.

I may mention beforehand that the classification of *Nisea*, *Leptoconchus*, *Melapium*, and *Separatista* is somewhat uncertain, and still more doubt can be entertained regarding *Pinaxia*; the genera themselves—except perhaps *Separatista*, which may rather belong to the *TRICHOTROPIDÆ*—require confirmation in many points, before they can be universally accepted and placed accordingly in the system. I shall therefore not include these doubtful genera in the present list, although the first three named, if otherwise correct, can scarcely be classed in any other family than this, the two former in the *PURPURINÆ*, the latter in the *RAPANINÆ*.

a. *Sub-family*.—*PURPURINÆ*.*

- Genera; 1. *Jopas*, H. and A. Adams, 1853 (Gen. I, p. 128).
 2. *Vexilla*, Swainson, 1840 (*ibid* p. 129).
 3. *Purpura*, Bruguiere, 1789 (*ibid* p. 126), with sub-genera, several of which may have generic value.
 4. *Purpuroidea*, Lycett, 1848.
 5. *Monoceros*, Lamarck, 1809 (*Acanthina* in H. and A. Adams', *Acanthiza* in Gray's Guide, 1857).
 6. *Mitrella*, Risso, 1826 (?) (*vide* Adams' Gen. II, p. 620).
 7. *Sistrum*, Montfort, 1810. (*ibid* Vol. I, p. 130).
 8. *Ricinula*, Lamarck, 1812, if worthy of distinction from the former; *Pentadactylus*, Klein, apud H. and A. Adams, loc. cit. I, p. 129.
 9. *Concholepas*, Lamarck, 1801. *Conchopatella*, apud H. and A. Adams, loc. cit. I, p. 132.
 10. *Magilus*, Montfort, 1810. *Campulotus* apud H. and A. Adams, loc. cit. I, p. 138.

Except *Purpuroidea*, a genus established for a jurassic group of shells, undoubtedly allied to *Purpura* (*in parte*), there are no secondary species as yet known¹ which may not be objected to as belonging to this sub-family. Of *Purpuroidea* itself only two cretaceous species have been reported: one of these occurs in the Alpine Gosau deposits, *P. Reussi*, Hörnes (Denksch. Akad. Wien, X, p. 177), but its

* *Purpurina*, D'Orb., belongs probably to the *TRICHOTROPIDÆ* (*vide postea*).

determination is not very certain. It is found with *POTAMIDINÆ*, certain species of *NATICIDÆ* and others, in at least partially brackish deposits, and it would not be very difficult to associate it with the *MELANOPSINÆ*. Gabb (Proc. Acad. Nat. Sc. Phil. 1860, p. 94, Pl. 2, Fig. 11), describes a *P. dubia*, but this is indeed more than doubtful, and judging from the figure, it can belong quite as well to any other even approximately allied genus.

Pictet (Mat. Pal. Suisse, 3me. Ser., p. 673), mentions from the Gault of Cosne an undescribed species which, he thinks, may belong to the *PURPURIDÆ*, but whether to this or the next sub-family is not yet known.

It is possible that the *Volula corrugata*, Binkh. (Monog. Gast. et. Céph. craie de Limbg., 1861, p. 14, Pl. V, Fig. 1), is a *Purpura*, if no columellar plaits exist.

Buvignier (Statist. d. l. Meuse) describes some jurassic *Purpuræ*; but these had better be referred provisionally to *Purpuroidea*, until the relations of this genus to *Stramontia* and *Thalessa*, two forms of shells, quoted as sub-genera of *Purpura*, are satisfactorily settled. It would appear that all three ought to form one genus, apart from *Purpura* proper.

b. Sub-family--*RAPANINÆ*.

The shells of this sub-family are distinguished by a comparatively very short spire, rapid increase and ventricose form of the last whorl, being anteriorly produced into a shorter or longer, but always distinct canal. The inner lip is always strongly developed, often thickened, toothed posteriorly or wrinkled in front; the umbilicus remains usually uncovered, at least partially.

The genera which appear to be admissible in this group are as follow :—

1. *Cuma*, Humphrey, 1797.
2. *Litixaxis*, Swainson, 1840.
3. *Rapana*, Schumacher, 1817.
4. *Rhizochilus*, Steenstrup, 1850.
5. *Vitularia*, Swainson, 1840.
6. *Morea*, Conrad, 1860.
7. *Rapa*, Klein, 1753.
8. *Tudicla*, Bolten, 1798.
9. *Whitneya*, Gabb, 1864, Calif. Palæont. I, p. 103; reminds one more of *Melapium*, II. and A. Adams (Genera, I, p. 136).
10. *Chorus*, Gray, 1847.

For the secondary deposits this sub-family is by much more important than the previous. Scarcely any jurassic species are known with certainty, but the number of cretaceous is comparatively large. Most of them have been described under *Pyrula*, and Keferstein (in Bronn's Klassen und Ordnungen des Thier-reiches, III, p. 1047) and others class in fact *Rapa*, *Rapana*, &c. with *Pyrula*, Lamarck, without acknowledging even a generic distinction. There is, however, not very much doubt now, that Lamarck's genus *Pyrula* cannot be retained, even when *Ficula* or *Sycotypus* have been separated, as proposed by Deshayes

and others. The same must be done with *Rapa* and other *RAPANINÆ*, *Melongena*, *Hemifusus* and other *FUSINÆ*, and what then remains to be called *Pyrula*, I am not prepared to say, nor is the matter involved in any way in the present discussion of our cretaceous shells. Dr. J. Müller, in his 'Petrefacten d. Aachner Kreideform.' 1851, pp. 39 and 40, was one of the first who directed attention to the cretaceous forms belonging to *Tudicla* (*Pyrella*) and *Rapa*, as being different from *Murex* and *Pyrula* respectively.

Gabb has distinguished in his catalogue a few species of *Rapa* and others belonging to this sub-family. Pictet and Campiche referred them all summarily to *Fusus*, in a similar manner as they have done in another place with *Aporrhais*. We cannot agree with this kind of generic classification.

The following is a list of the species which have been made known from the cretaceous deposits, and which appear to belong to this sub-family; the names of the genera to which they show at least the nearest relation are noted in a parenthesis :—

EUROPEAN SPECIES.

1. *Rapa depressa*, Sow. sp., Gabb, Am. Ph. Soc. VIII, p. 130; *Pyrula* id. Sow. Trans. Geol. Soc. London, IV, p. 242, Pl. 18, Fig. 20—(may be a *Tudicla* or *Rapa*).
2. *Pyrula Brightii*, Sow., *ibid*, Pl. 18, Fig. 21; *Fusus* id. auctorum—(probably a *Rapa*).
3. *Fusus clathratus*, Sow., *ibid*, Pl. 18, Fig. 19; *F. subclathratus*, D'Orb. Prod. II, page 1551—(may be a *Rapa*, but the original specimen was very imperfect and nothing has been made known since).
4. *Pyrula planulata*, Nilss. Römer, Norddeutsch. Kreid., p. 78, Pl. 11, Fig. 11; *id.* Geinitz, Reuss.; *Pyrella* id. Müller, Petr. Aach. Kreidef. II, 1851, p. 39—(probably a *Tudicla*).
5. *Pyrula carinata*, Römer, N. Kreidef., p. 78, Pl. 11, Fig. 12—(? *Rapa*).
6. *Pyrula coronata*, Röm. N. Kreidef., p. 78, Pl. 11, Fig. 13; *idem* Geinitz and others; *Rapa* id. Müll. Petr. Aach. Kreidef. II, 1851, p. 40—(probably a *Rapa*).
7. *Pyrula costata*, Röm. N. Kreidef., p. 79, Pl. 11, Fig. 10—(? *Rapa*).
8. *Pyrula carinata*, Münst. Goldf. Pet. Germ. Gast. p. 27, Pl. 172, Fig. 11; *Fusus carinatus*, D'Orb. Prod. II, p. 229; Kner, in Haidinger's Abhandlg. III, 1850, Pl. 4, Fig. 7—(may be a *Rapa*; the form in Goldfuss resembles rather a *Tudicla*).
9. *Pyrula sulcata*, Kner, in Haidinger's Abhandlg. III, 1850, p. 22, Pl. 4, Fig. 8; *Fusus Althii*, Kner, Denksch. Akad. Wien, 1852, Vol. III, Pt. II, p. 309, Pl. 16, Fig. 13—(probably a *Rapa*).
10. *Pyrella Benthiana*, Müller, Petr. Aach. Kreidef. II, 1851, p. 39, Pl. 6, Fig. 7—(perhaps a *Rapa*, but no sufficient evidence can be derived from the description or figure).
11. *Rapa Monheimi*, Müller, Petr. Aach. Kreidef. II, 1851, p. 40, Pl. 5, Figs 22 and 23—(the transverse ribs terminating below the suture in strong tubercles are of a form somewhat unusual in *Rapa* and more characteristic for *Hemifusus*; nothing about the umbilicus, or the flattened columella, is noticed in the description above referred to, but the species may remain provisionally as here classed, until a chance may occur of examining the specimens again).
12. *Pyrula filamentosa*, Binkhorst, Mon. Gastr. etc. Mæstricht, 1861, p. 7, Pl. II, Fig. 5a, (may be a *Rapa*; *vide Rapa cancellata*, Sow. sp. 155).
13. *Pyrula tuberculosa*, Binkhorst, *ibid*, p. 8, Pl. 7, Fig. 5—(probably *Rapana*).
13. *Pyrula planissima*, Binkhorst, *ibid* p. 8, Pl. V^a, Fig. 3—(much resembling *Tudicla erimiu*, n. sp. *vide* p. 151).

14. *Pyrula nodifera*, Binkh., *ibid*, p. 57, Pl. V^a 3, Fig. 11—(of a similar form to *P. filamentosa*, only with somewhat higher spire; but equally doubtful as to generic determination).

15. *Pyrula parvula*, Binkh., *ibid*, p. 67, Pl. V^a 3, Fig. B^a b,—(perhaps a *Rapana*; at least the thickness of the columella, observable in Fig. B^b, makes it very probable that the species belongs to this subfamily).

16. *Pyrula? plicata*, Binkh., *ibid*, p. 68, Pl. V^a 3, Fig. A^a b—(probably *Rapana*, belonging to those small forms similar to Adams' *Coralliophila*.*

17. *Pyrula subcarinata*, d' Arch. (Mem. Soc. Geol. France, II, Ser. II, Vol. p. 345, Pl. 25, Fig. 7), which D'Orbigny called in the Prodrôme *Fusus Galathea*, is probably a *Tudicla*, certainly not a *Fusus*.

It is difficult to pronounce an opinion on the *Pyrula Smithii*, Sow. (Trans. Geol. Soc., London, Ser. II, Vol. IV, Pl. 11, Fig. 15). Sowerby already supposed, that he may have figured two species. Seeley (Ann. Mag. Nat. Hist. Ser. III, Vol. VII, p. 282), thinks that the Fig. 15a may belong to his *Pteroc. globulatum* (*ibid*, p. 281), and proposes for the species figured in 15b the name *Pyrula Sowerbii*. I would much rather believe that the species belongs to *Rapa* or to *Hemifusus*, than to *Ficula* = *Sycotypus* (*Pyrula* in parte).

AFRICAN SPECIES.

18. *Pyrula cretacea*, Coquand, Paléont. Const. 1862, Pl. II, Fig. 12—(is a very doubtful cast, the general form and the indication of a laterally bent canal recall a *Rapa*).

AMERICAN SPECIES.

19. *Rapa pyruloidea*, Gabb, Proc. Acad. Phil. 1860, p. 94, Pl. II, Fig. 4—(doubtful cast).

20. *Rapa supraplicata*, Conrad, Jour. Acad. N. Sc. Phil. III, 1858, p. 332, Pl. XXXV, Fig. 20—(equally doubtful).

21-22. *Pyrula (Fusus) longirostra*, & *P. Hombroniana*, d'Orb. Voy. Astrol. Paléont. 1847, pl. I. figs. 30-31; (belong most probably both to *Rapa*); the species are from Chili.

23. *Tudicla elevata*, Gabb, *Rapa idem*. Jour. Acad. N. Sc. Phil. II, Ser. IV, p. 301, Pl. XLVIII, Fig. 12.

24. *Tudicla perlata* (*Pyropsis id.*) Conrad, Jour. Acad. Nat. sc. Phil. II, Ser. IV, p. 288, Pl. XLVI, Fig. 39—(well preserved and typical form).

25. *Tudicla trochiformis*, Tuomey, sp. (Gabb, in Am. Phil. Soc. VIII, p. 141, states, that the former is probably identical with this species).†

26. *Morea cancellaria*, Conr. Jour. Acad. Nat. Sc. Phil. II, Ser. IV, p. 290, Pl. XLVI, Fig. 30.

27. *Morea naticella*, Gabb, *ibid*, p. 301, Pl. XLVIII, Fig. 15—(doubtful).

28. *Whitneya ficus*, Gabb, Pal. Calif. 1864, I, p. 104, Plate XXVIII, Fig. 216.

INDIAN SPECIES.

The following are described here from the South Indian cretaceous rocks.

29. *Tudicla eximia* n. sp.

30. *Rapa cancellata*, Sow., sp.

31. *Rapa nodifera*, n. sp.

32. *Rapa Andoorensis*, n. sp.

33. *Rapa corullina*, n. sp.

34. *Rapana tuberculosa*, n. sp.

We may safely state, that the Indian species are so far well preserved as to admit at least of a tolerably certain generic determination, and as regards the sub-family there can be no doubt whatever. This, however, is by no means so certain with reference

* *Pyrula ambigua* and *fusiformis*, Binkh., have rather the form of *FUSINÆ*.

† Meek. ('Check List of cretaceous invert. Foss. of N. America,' 1864, p. 23) refers *Busyon Bairdi*, and *Fusus Dakotensis*, to *Tudicla*.

to the other known species, which have been quoted. Excepting the *Tudicla perlata*, Conr. (prob. *T. trochiformis*, Tuom.), *Morea cancellaria*, Conr., *Whitneya ficus*, Gabb we may say, that there is not a single species the generic determination of which was unquestionable; the largest number of them being based upon imperfect cast specimens. The most probable are those described by Binkhorst from the Mæstricht Chalk and, so far as the sub-family is concerned, they cannot be very much doubted. But supposing the most unfavorable case, that only little more than one-half of the species, which we have quoted, are found correct, we have still a fair number of cretaceous *Rapaninæ*, amounting to 16 species, a number to which the tertiary species scarcely attain, showing thus the importance of the study of the *Purpuridæ* for the cretaceous deposits. It is remarkable, that scarcely any representatives of this sub-family are known from the cretaceous deposits of Southern Europe, while the species in the deposits of Northern Europe, as in England, Germany, Bohemia and Galicia, are by no means rare, even as regards individuals. The difference seems actually to exist, as it cannot be entirely due to a better and more extensive knowledge of the fossils of the northern cretaceous deposits. I never met with a species of this sub-family in the deposits of the Alpine Gosau formation, although I had repeatedly occasion to look over large collections from these beds, and to a great extent examined the same also in situ.

XXXVII. TUDICLA, Bolten, 1798.

Char. *Testa fusiformi, spira brevi; ultimo anfractu ventricosus, antice canali prolongato; apertura ovali seu rotundata, postice subcanaliculata; labio calloso, postice plicose-dentato, antice applanato, intus acute angulato atque plicam formante; columella late excavata.*

The posterior tooth on the inner lip and the anterior fold of the same may be considered as the principal distinction between *Tudicla* and *Rapa*; the length of the canal is probably also characteristic, and is well developed in *Rapa* only in younger specimens. The papillary apex must be excluded from the character, as it does not exist even in such typical forms as *Tudicla rustica*, Bast., which several conchologists up to the present time consider as identical with *T. spirilla*.

I adopt here Bolten's name, not because I would favor any ill-founded claim of priority against *Pyrella* or *Spirilla*, but because the name *Tudicla* is not likely to be so easily mistaken, and is in reality better known than any of the former, specially through Adams' and Chenu's conchological works, and because it has already become familiar in palæontological literature as well. It is quite the same in the case of this genus as with *Neptunea* of the *FUSINÆ* and many others.

Several conchologists may think it a novelty to find the genus classed here. I do not know more about the living shells than is stated in known conchological publications, and I have been led to the present placing of the genus in this sub-family merely by the very great resemblance of the form of the shell to that of

typical species of *Rapa*. This resemblance not only exists among the recent forms, but is rather more distinct in the fossil. In fact, when the posterior fold-like tooth, the anterior fold of the inner lip and the termination of the canal, are not well preserved or only somewhat obliterated, I do not know how to find it possible to distinguish these two genera. This resemblance appears to become greater the lower we descend in the age of the deposits, and it is the principal reason which I can produce in favor of the classification here adopted.

H. and A. Adams refer *Tudicla*,* to the family *FASCIOLARIIDÆ* and Chenu retains it in the same. Other conchologists class the few recent species either with *Pyrula* or *Murex*, and Gray in his last catalogue, 1857, p. 11, calls *Tudicla spirilla* an "unarmed *Murex* with rudimentary varices" "*(Pyrenella)*." There can be no question that the shell of *Tudicla* very much resembles a *Murex* (the genus, as restricted), but certainly the total want of varices is something very distinct; as regards that point the shell has evidently more relation to *Rapa*, which opinion seems to have been suggested already in 1851 by Dr. J. Müller. We cannot expect a final decision on this and other similar points until the animal and the operculum of *Tudicla* have been made known. The affinities to *Pyrula* must be dropped, and this the more, as there is scarcely anything for which the name *Pyrula* can be retained. The name itself will probably disappear after a little time from our conchological lists altogether. The cretaceous species belonging to this genus have been noticed previously; their total number amounts to about six.

1.—*TUDICLA EXIMIA*, *Stoliczka*. Pl. XII, Figs. 5-8.

Tud. testa spira brevissima; anfractibus quinis, ultimo maximo, ventricoso, prope suturam tumescente, postice lente excavato, antice applanato, ad peripheriam bicarinato; carina superna fortiori, nonnunquam obsolete-nodulosa (infra quam interdum carina altera, tenuior sita est); superficie lævigata seu distanter spiraliter striata; rostro antice (?) prolongato; apertura fere circulari, intus lævigata; labro ad marginem obsolete undulato; labio callosissimo; umbilico aperto.

The form of the shell seems so far pretty constant that the spire is never much elevated, and the last whorl embraces all the previous. There are at least two keels present on its periphery, the upper of which is stronger. Some specimens have only one keel below the two primaries, and a second anterior one indicated (Fig. 6); others have a keel below each of the primaries (Fig. 5). In large specimens (Fig. 7) the keels become almost obsolete towards the aperture, where the striæ of growth are much more strongly developed; these occasionally cause the appearance of slight tuberculations on the uppermost keel, and are always distinctly marked on the shell. The surface is besides sometimes covered with distant spiral striæ, which are very fine, but also disappear near the aperture.

* H. and A. Adams propose for two species *T. spinosa* and *armigera* a new generic name, *Tudicula*, which ought to be distinguished by spinous varices and three columellar plaits, and is most nearly allied to *Turbinella*. The form of the columella is not particularly alluded to, whether it is flattened or not, but from the existence of numerous columellar plaits it is likely to be different from that of *Tudicla* (*vide* Proc. Zool. Soc. 1853, p. 429).

The sutural margin of the last whorl is thickened, the upper portion slightly excavated, and naturally also the space between the keels on the periphery. The aperture is nearly circular, internally smooth; the posterior canal is distinct, and also the fold-like tooth near the same; the outer lip has a slightly undulating peristome the inner lip is very thick, with the anterior fold distinctly marked; the columella widely excavated and the canal produced, its margins approaching anteriorly very closely so as to leave only a narrow slit open. The anterior portion of the canal is not preserved in any of our specimens, but, to conclude from the remaining indications, it seems to have been somewhat contorted and laterally curved, as in *Tud. porphyrostoma*. Casts of this species are almost identical with *Pyrula planissima*, Binkhorst (Monograph. Gast. et. Céph. de Limbg., p. 8, Pl. V^a, Fig. 3), for which reason we have given a representation of a similar cast in Fig. 8); but who can vouch for the identity of these two fossils! According to Binkhorst's Fig. 3c, the European species seems to have the inner lip less thickened, especially near the posterior canal, and the whorls more evenly rounded in the circuit. Until better specimens are found of the Mæstricht fossil, nothing can be done save to keep both forms under separate names.

Localities.—N. E. of Karapady and near Arrialoor, in the Trichinopoly district; not rare.

Formation.—Arrialoor group.

XXXVIII.—RAPA, Klein, 1753.

Char. *Rapa testa pyriformi, spira brevi; ultimo anfractu ventricoso; antice canali prolongato; columella excavata; apertura subrotundata; labio lævigato, antice applanato, margine externo excavationem columellæ sæpius partim tegente.*

"*Rapa*," say H. and A. Adams in their Genera, I, p. 137, "differs from *Rapana* not only in the produced canal of the aperture and thin simple whorls, but in the free, reflexed inner lip and moderate umbilicus." The distinction indicated in the living *R. papyracea*, Lam., to which Chenu added the *R. tubulosa*, seems equally to exist in the fossil species, and it is therefore desirable that the same ought to be generically noticed, specially as the fossil forms seem to be by far the more numerous. A marked characteristic of *Rapa* seems to be throughout common, namely, that the anterior canal is proportionally much longer in young than in fully grown specimens of the same species. This is a well known fact in *Rapa papyracea*, and we have here occasion to exhibit it on the cretaceous *R. cancellata*, Sow. (compare the figures on Plates XII and XIII). It is probable that this distinction is valuable as regards *Tudicla*, in which such an alteration of form has not been observed.

The relation of the shell of *Rapa* to that of *Murex* is about the same as that of *Tudicla*; and from *Rapana* it differs in an equal degree, as *Cuma* from *Monoceros*.

The number of fossil and especially cretaceous forms belonging to *Rapa* seems to be very great, as has been noticed previously, but the usual want of the canal in the fossil state makes the determination very often uncertain.

1.—RAPA ANDOORENSIS, *Stoliczka*. Pl. XII, Fig. 9.

Rap. testa ultimo anfractu ventricosus, ad peripheriam bicarinato, carina superna fortiori, nonnunquam subtuberculata; superficie spiraliter striata; striis alteris transversalibus incrementi æqualiter tenuibus interruptis, ultimis interdum sub-granulosis; spira parum elevata; apertura oblique quadrangulari, intus lævigata; labio moderate callosus, antice applanato, intus subangulato; columella aperta; canali prolongato, vix contorto?

The principal characteristics of this species consist in the two keels, the numerous spiral striation, increasing gradually in number according to the size and width of the whorls, the squarish and oblique shape of the aperture, and probably a comparatively lengthened canal. There cannot be a difficulty in distinguishing well preserved specimens from *Tudicla eximia*, n. sp., but in the case of imperfect specimens on both sides, it is almost impossible to succeed. The inner lip is much thinner than in *Tudicla eximia*, but has no posterior fold-like tooth, and is anteriorly distinctly flattened and internally angular, without forming, however, a distinct fold, as in *Tudicla*.

The striæ of growth are usually well marked, and on the upper flattened portion of the whorls bent in S-form; they produce occasionally a fine granulation on the spiral striæ, and on the upper keel even a kind of depressed tubercles.

Locality.—Andoor and Coonum, in the Trichinopoly District; very rare; one specimen is from Odium in the Ootatoor group, but being only a cast its determination is somewhat doubtful.

Formation.—Trichinopoly group.

2.—RAPA NODIFERA, *Stoliczka*, Pl. XII. Figs. 10 and 11.

R. testa ventricose-turbinata, spira brevi, anfractibus 3-4 composita; ultimo anfractu ad peripheriam valde angulato, noduloso, postice lente excavato, spiraliter striato, liris granulosis cingulato, antice canali (?) extenso; apertura rotundate angulari, postice subcanaliculata, intus lævigata; labro ad marginem incrassato; labio tenui, antice applanato.

This species is chiefly characterized by the strongly tuberculated keel, thin inner lip of the aperture, and apparently a rather more produced canal than in *Rapa cancellata*, Sow. The spire is short, composed of three or four volutions, all being slightly excavated above, covered with spiral striæ, and provided with small tubercles along both sutures. Below the principal keel there are one or two thinner keels or rather tuberculated ribs, and then again one stronger, being equivalent to the second keel of the former species; the rest of the shell is ornamented with spiral granulated striæ, somewhat thinner than the sulci separating them. Towards the margin of the aperture the striæ and tubercles mostly disappear. The posterior canal is distinct, the inner lip next to it somewhat thickened, but otherwise much thinner than in any of the other species. The excavation of the columella is partly covered, and the canal very narrowly open in front.

Locality.—Coonum, Andoor, S. of Serdamungalum, and Kolakonuttom, in the Trichinopoly group; not common.

Formation.—Trichinopoly group.

3.—*RAPA CANCELLATA*, Sowerby, *sp.* Pl. XII, Figs. 12—16, & Pl. XIII, Figs. 1—4.

1846. *Pyrgula cancellata*, Sow., Forbes, Trans. Geol. Soc. Lond., VII, p. 128, Pl. XV, Fig. 12.

1850. *Fusus Forbesianus*, D'Orb. Prodrôme, II, p. 229; *idem* Pictet, Gabb., and others.

R. testa ventricosa; spira brevi; anfractibus quinis, postice applanatis seu lente excavatis; ultimo ad peripheriam bicarinato: carina superiori acuta, fortiori, inferiori nonnunquam obsoleta; canali contorto, apertura marginem exteriorem versus curvato; columella plus minusve excavata; superficie striis spiralibus granulosis ornata, nonnullis minoribus, alteris prope suturam atque in carinis fortioribus; apertura elongata; canali aperto; labio calloso, antice applanato; labro in ætate juniori tenui, ad marginem intus sulcato, in ætate proveciori incrassato, obsolete sulcato.

The form of this species is rather variable, as may be seen upon a view of the figures given on Plates XII and XIII. The spire of the shell is always very short, the last whorl ventricose, and above, like all the previous, flattened or even slightly excavated. On the periphery there are usually two keels present, the upper one being much stronger, and the lower becoming occasionally obsolete in more fully grown shells. The entire surface is covered with granulated spiral striæ, those near the suture and on the keels being much stronger. Sometimes the transverse ribbings form stronger tuberculations on the peripheral keels, while the other spiral striæ are comparatively much thinner.

The aperture is angularly elongated; the posterior canal is slight, but always distinctly marked. As in the typical, living, *Rapa papyracea* the anterior canal is in young specimens proportionally much longer than in old ones. It is not perfectly preserved in any of our numerous specimens, but in Fig. 12, Pl. XII, it is nearly complete. From this it was evidently somewhat contorted and bent back towards the outer margin of the aperture. The inner lip is considerably thickened, smooth, anteriorly flattened, covering with its margin the termination of the columella sometimes perfectly, or leaving it widely open. The outer margin is thin and internally sulcated in young specimens (Figs. 13 and 14, Pl. XII), while in full growth it is much thickened (Fig. 1, Pl. XIII).

The specimen figured by Forbes was no doubt partially a cast, and his description must have been derived from other better preserved individuals; the lower peripheral keel seems to have been not much developed, and on casts it is actually scarcely traceable. From some specimens in the Madras Museum there can be little doubt that Sowerby and Forbes had the fossil, as here specified, under consideration. It is one of the most common species, and tolerably well characteristic for the Trichinopoly group.

I could have added as a synonym of this species the *Pyrula filamentosa*, Binkhorst (Mon. Gast. et Céph. de Limbg., 1861, p. 7, Pl. II, Fig. 5) from the upper cretaceous deposits of Limbourg, if there was not a doubt about one all important point. A comparison, for instance, of Binkhorst's Figure with our Fig. 3 on Pl. XIII leaves actually no other specific distinction between the two, except that in our species the anterior portion of the inner lip is distinctly flattened, while in Binkhorst's figure there is even no trace of such a flattening. This is, however, in the determination of the genus so very important that in case the Mæstricht species does not actually possess that flattening, it must strictly be referred to the sub-family *FUSINÆ*, either to *Perissolax* or *Hemifusus*, although for my own part I would almost believe, that just at this point the fossil was not so well preserved as would seem desirable.

Localities.—Neighbourhood of Anapady and Andoor; N. of Alundanapooram; N. of Serdamungalum; W. of Kullygoody, Shutanure, Kolakonuttom, &c.

Formation.—Trichinopoly group; chiefly in light coloured sandstones all along the frontier towards the Arriallor group.

4.—RAPA CORALLINA, *Stolizcka*. Pl. XIII, Fig. 5.

R. testa pyriformi, spira brevi, conica, acutiuscula; ultimo anfractu ventricosus, postice planiuscula, obsolete striato, margine suturali tumescente, supra medium angulato, obtuse carinato atque tuberculato, antice sulcis angustis spiralibus et distantibus notato, canali recurvo et contorto prolongato.

A small pear-shaped shell with a short pointed spire and a roundish last volution. Along the suture the margin of the whorls is somewhat thickened, below they are flattened, and then obtusely angulated and tuberculated. The greater portion of the last whorl is covered with spiral sulci which are much narrower than the striæ between them. The canal is tolerably long, contorted and somewhat recurved; the excavation of the columella only slightly indicated. Excepting fine striæ of growth there are no stronger transversal ribs.

This species is of all known cretaceous fossils most nearly related to *Fusus Tippana*, Conrad (Jour. Acad. Nat. Sc. Phil., Vol. IV, p. 286, Pl. 46, Fig. 41) from Mississippi and indeed so much so, that were it not for the stronger tubercles on the last whorls, and for the want of the thickened posterior sutural margin on the whorls, both could be easily identified. In fact, if it could be proved that the want of the ornamentation on the spire has been caused in the American species by an erosion of the surface, there would scarcely remain sufficient ground for not carrying out this identification.

Locality.—Ninnyoor; not rare; in a white sandy limestone with some *CYPRÆIDÆ*, *VOLUTIDÆ*, Corals, and other fossils. The species appears to be very characteristic for these coralline beds.

Formation.—Arriallor group.

XXXIX.—RAPANA, *Schumacher*, 1817.(Probably including *CORALLIOPHILA*, Adams).

Char. *Rapana*, testa sub-pyriformi seu sub-globosa, crassa; spira brevi; ultimo anfractu ventricosus, antice canali brevi atque recurvo producto; terminatione columellari aperta.

The distinction between *Rapana* and *Rapa* has been already referred to; it lies principally in the length of the canal of the latter genus. Gray (Guide, 1857, p. 19) says that *Rhizochilus*, Steenstrup, is a *Rapana* that lives on *Anthipathes*, and at certain periods of its life closes its shell with a calcareous secretion, and permanently fixes itself to the coral, where it eventually dies. As the species, known under the name of *Rhizochilus antipathicus*, Steenst. possesses, however, even in the young state a prolonged canal, which it afterwards closes perfectly, it may be, we believe, correctly separated under a special generic name, but there appears to be rather a doubt as to those species which H. and A. Adams consider a sub-genus of *Rhizochilus* and call *Coralliophila*. If in other ways the animals of *Coralliophila* do not exhibit any particular distinction, I think they cannot be viewed as any thing else but *Rapana* of small size living on corals, as already stated by Dr. Gray.

There is among our materials only one species, which we can refer to this genus; it is small, but when compared with specimens of *Rapa* of equal size, the shell is at least twice as thick. It has all the principal characters of the genus.

1.—RAPANA TUBERCULOSA, *Stoliczka*. Pl. XIII, Fig. 6.

Rap. testa globosa, crassa, spira brevissima; ultimo anfractu ventricosus, costis numerosis spiralibus, tuberculatis, sulcis profundis angustisque separatis ornato; apertura subrotundata, postice effusa; labro ad marginem undulato; labio calloso, postice dentato, ad medium arcuato atque transversim rugoso, antice applanato et interne angulato; columella ad terminationem excavata; canali brevioris, angustissimo, recurvo.

Shell rather globose, consisting of about three volutions, the last of which envelopes the previous nearly completely, being strongly convex and inflated. The surface presents seven spiral ribs, provided with comparatively large tubercles and separated by narrow and deep sulci. The third rib from the suture is the strongest, forming a kind of keel. The aperture is roundish, posteriorly with a narrow canal; the outer lip has an undulating, sharpened margin; the inner lip is very thick, posteriorly toothed, in the middle cross-wrinkled, anteriorly flattened and internally angular. The canal is short, recurved towards the outer lip, opening in front with only a narrow slit. The columella is largely open and margined in front by the inner lip and backwards by the sharpened edge, which is produced by the anterior emargination of the canal. As regards ornamentation this species agrees markedly with *Morea cancellaria*, Conrad (Journ. Acad. Nat. Sc. Phil. IV, p. 290, Pl. XLVI, Fig. 30), but it is much more semi-globose,

broad and shorter than the American type. I must remark here that the above description has been taken from the single specimen, before it became unfortunately injured by dropping accidentally into a bottle with acid. It could not be saved until the surface had become rather corroded and polished in place of the tubercles, which, therefore, are only indicated in the representation on Pl. XIII, Fig. 6.

Locality.—Serdamungalum, in hard siliceous sandstone.

Formation.—Trichinopoly group.

XV. Family—*TRICHOTROPIDÆ*.

Vide Adams' Gen. I, p. 278; Gray's Guide, 1857, pp. 43 and 77, *VERENADÆ* and *Trichotropis*; Chenu's Man. I, p. 278.)

It will be sufficient to refer here to the above papers, in which the organization and the peculiarities of the animals of *Trichotropis* will be found treated at length.

Gray places *Trichotropis* in the family *APORRHAIIDÆ* (sub-fam. *APORRHAINÆ*), for which scarcely any other reason than the similarity in the dentition can be given, although this appears to be by no means constant, as seen by a comparison of the teeth of *Trich. borealis* and *bicarinata*. Speaking of the *VERENADÆ* (= *Trich. borealis*, l. cit. p. 43; *Verena* id. p. 44—not *Verena*, Adams; *Tropiphora* id. p. 77), Gray says, "this family is the Buccinoid representative in this group," and comparing the animal with that of *Purpura*, or for instance of *Cominella* of the *BUCCINIDÆ*, the resemblance will be found far greater than at first sight it would appear. The operculum in form and position in the aperture is unquestionably more like the *BUCCINIDÆ* than *Aporrhais* or *Struthiolaria*. The shell appears in reality to form a transition between *Rapana* of the *PURPURIDÆ* and *Trigonostoma* of the *CANCELLARIIDÆ* and the place which has been assigned to the *TRICHOTROPIDÆ* by II. and A. Adams next to the last named family appears certainly the most probable to be correct. The tropical forms of *Trichotropis*, like *T. cancellata*, in their ornamentation resemble *Cancellaria* still more. Species of *Trigonostoma* would in fact be inseparable from *Trichotropis*, if they had no columellar plaits, so far as the form of shell is concerned, but its thickness may be said without exception to be greater in the former than in the latter genus, and if this could be considered of greater value than the want of columellar plaits, we cannot help confessing that the two species which we note under *Trichotropis* would have to be classed in the *CANCELLARIIDÆ*. It must, however, be remembered that the single lamellæ, which compose the shell of *Trich. Konincki*,—the only species we can consult, the other one being imperfect and doubtful,—are quite as thin as in living species of *Trichotropis*, and that the thickness of the total shell is only produced by their overlapping each other.

Alora, Adams, 1861 (Proc. Zool. Soc. Lond. p. 272) has been proposed for an American species (*A. Gouldii*) with a very small umbilicus, and a produced, anteriorly non-canaliculated aperture. This character evidently recalls very much the form of many fossil species of *Purpurina*. It would seem that *Separatista*, Gray,

classed by Adams (Gen. I, p. 136) in the sub-family *RAPANINÆ*, ought to form a genus in the *TRICHOTROPIDÆ*, although Gray (Guide, 1857, p. 77) appears to unite it again with *Trichotropis*.

There are only very few fossil forms known which belong to this family. Gabb. (Pal. Calif. I, 1864, p. 138, Pl. XXI, Fig. 98) described lately a remarkable shell from the cretaceous rocks of California as *Lysis duplicosta* (n. gen. et sp.), which has the general form of *Fossar*, and partly that of *Narica* and *Stomatia*. Should it not belong to the *NATICIDÆ* or the *VELUTINIDÆ*, which is, more likely, its only place would be in this family next to *Separatista*, Gray, although it is, properly speaking, very much allied to *N. carinata*, Sow., sp. (Trans. Geol. Soc. Lond., IV, Pl. XVIII, Fig. 8), which is very probably a *Fossar*.

The jurassic genus *Purpurina*, D'Orb., includes shells of the *Cancellaria*-or *Trichotropis*-form, anteriorly with a slightly produced aperture and an obsolete notch occasionally. The genus is generally classed with the *BUCCINIDÆ*; but if we take the total form of the shell and that of the aperture into consideration, there is certainly no other family, the species of which possess quite similar characters, excepting that of the *TRICHOTROPIDÆ*. Besides this relation *Purpurina* offers none to any other family excepting the *LITTORINIDÆ*.

There are about 14 living species of *Trichotropis*, a few tertiary, and only one doubtful cretaceous species described under this genus by Conrad, *T. cancellaria*, (Journ. Acad. Nat. Sc. Phil. III, pp. 333 and 336, Pl. XXXV, Fig. 8) from Mississippi.

XL. TRICHOTROPIS, Sowerby et Broderip, 1826.

1. TRICHOTROPIS KONINCKI, Müller, sp. Pl. XIII, Figs. 7—9.

1851. *Trochus Konincki*, Muller, Petr. Aachner Kreide, II, p. 44. Pl. V, Fig. 11.

1864. *idem*. Pictet, Pal. suisse, 3me. Ser. II, pt. p. 533.

Trich. testa ovato-turbinata, columella excavata; anfractibus quinis, primis lævigatis, ceteris spiraliter dense striatis, infra medium acute carinatis, supra atque infra carinam plus minusve excavatis, transversim lamellose costulatis; costulis ad carinam plus minusve acute-elevatis seu coronatis; ultimo anfractu inflato, spira altiore, ad medium bicarinato, carina infera tenuiore; umbilici margine crasse carinato; apertura ovali, antice subemarginata, marginibus lævibus, dilatatis, postice continuis.

Spiral angle about 70°; sutural angle 12°.

Height of last whorl : total of shell (considered as 1 00) ... 0.54—0.63.

The height of the spire is somewhat variable in this species, although the number of whorls is usually only five. The last whorl, being, however, more or less inflated, covers a greater or smaller portion of the preceding whorls (each respectively), and the consequence is, that not only the spire becomes shorter, but that the carina of each whorl is in the first case nearer to the middle (see Fig. 7), in the other nearer to the lower suture (Fig. 8). On the last whorl there is always a second

keel below the upper principal one, and occasionally in large specimens even a third one is indicated; the former remains sometimes perceptible on the suture of the preceding whorls, when the spire is more turbinate.

The transverse ribs are simply the remainders of the margins of the outer lip, in no way thickened, and following closely each other like the slates of a roofing. On the keels they are more or less elevated, laminar,—probably they were more so in the living shell—and placed very similarly to those in the recent species, *Tr. bicarinata* and others. The spiral striæ are very numerous and of unequal strength; they are less marked, when the transverse ribs are stronger, but when these—in the young shell—are very slight, the spiral striation appears the more distinct (see Fig. 9). The aperture is oval, very oblique, with flattened and somewhat expanded margins, which are posteriorly thicker and united; both are entirely smooth internally and there is not a trace perceptible of any fold in the total length of the columella. The latter is hollowed out and on the last whorl strongly edged with a lamellar keel, terminating at the anterior notch of the aperture (sub-gen. *Iphina*, H. and A. Adams).

This species attains a considerable size, the largest specimen from Shutanure measuring 57mm. in height and 43mm. in width on the last volution. I have already noticed the similarity of this species to other tertiary *Trigonostoma*. There can be scarcely a doubt, that our fossil is identical with that described by Müller. As it is evident from our figures that the form of the shell varies with the height of the spire, there does not remain the slightest character, which could justify the separation of the Indian from the European species. Müller (loc. cit.) exerted himself in vain to prove the non-existence of the genus *Delphinula*, evidently merely to find a place for his very remarkable fossil in a generalisation of the character of *Trochus*; but his propositions certainly have no chance of being appreciated by most other conchologists, in fact they have remained unnoticed.

Localities.—N. of Kunnanore, E. of Anapady, and S. W. of Shutanure; at the former localities the species does not appear to be rare.

Formation.—Trichinopoly group.

2. TRICHOTROPIS NODULOSA, *Stoliczka*, Pl. XIII, Fig. 10.

Trich. testa rhomboidali, spira ultimo anfractui in altitudine fere æquali; anfractibus circiter quinis, infra medium rotundate angulatis, ad angulum tuberculatis; superficie spiraliter striata, striis inæqualibus, ternis medianis crassissimis; collumella excavata, lævi, antice truncata.

Spiral angle 80°; sutural angle 8°.

Height of last whorl : total of shell (considered as 1·00) ... 0·55

The form of the shell, as a whole, is obliquely rhomboidal, consisting of about five volutions only, the last of which does not much exceed the height of the spire. The embryonal whorls are not preserved in our specimen; all the others are nearly

flat above, and at about the middle roundly angulated, each of the succeeding whorls reaching high up towards the angle, and covering the greater portion of the lower half of each preceding whorl. There are about twelve blunt, transversally elongated tubercles on the angle of each volution, being produced by a thickened elevation of the margin of the outer lip on the same, and disappearing quickly towards the sutures. The entire surface is covered with spiral striæ, unequal among themselves, generally alternately thinner and thicker; three are placed posteriorly, and the four which cross the tubercles, and which are all visible only on the last whorl, are the strongest of all.

The columella is hollow, and the inner lip without a trace of folds, as the interior, truncate edge of the canal, indicating a notch, cannot be compared with a fold or tooth. The margins of the aperture are not preserved, and remain to be traced; but judging from the total aspect of the shell, and its resemblance to the other species of *Trichotropis*, combined with the total want of any columellar plaits, there can be but little doubt that the species belongs to this genus.

Locality.—S. W. of Alundanapooram; the figured specimen is as yet unique.

Formation.—Trichinopoly group.

XVI. Family—*CANCELLARIIDÆ*.

(Vide Adams' Gen. I, p. 275; Gray's Guide, 1857, p. 23; Chenu's Manual I, 274).

The anatomy of the animals of the *CANCELLARIIDÆ* is in many respects as yet defectively known, but as regards the structure of the shell there is no question, that the place assigned by H. & A. Adams to the family, close to the *CERITHIIDÆ*, cannot be seriously objected to. In having generally a distinct siphonal fold on the mantle, and usually a more or less distinct canal on the shell, they undoubtedly ought to be located not far from the *CERITHIIDÆ* and towards the end of the *SIPHONOSTOMATA*, forming thus gradually a passage to the *HOLOSTOMATA*. There are some points of relation between the *CANCELLARIIDÆ* and the *TEREBRIDÆ*, which we shall notice subsequently.

The proboscis of the animal of *Cancellaria* is very short and rudimentary; the eyes are usually sessile on the outer side of prolonged tentacles, which are thickened, and close together near the basis; teeth and operculum are not exactly ascertained, although the former are stated by Troschel to resemble those of the *CONIDÆ*; these and other doubts increase a little the difficulty of classification, as I shall subsequently mention again in the *TEREBRIDÆ*. Looking to the shells of fossil as well as living species of the *BUCCINIDÆ* and *PURPURIDÆ* on one, and the *TEREBRIDÆ* and *CERITHIIDÆ* on the other hand, they seem to be well placed between these two families. I would on this occasion recall the eocene species *Buccinum fusiforme*, Desh., *B. Andrei*, Bast. *B. Vicaryi*, d'Arch. (India), or the miocene *Buc. turbinellus*, Brocc. and other species, which have probably to be withdrawn from the *BUCCINIDÆ* and placed in the family *CANCELLARIIDÆ*.

H. and A. Adams divide the family into two genera, *Cancellaria* and *Admete*, and quote a number of subgenera of the former. It is certain that the difficulty of distinguishing the quoted subgenera of *Cancellaria* is very great, although every one, who had studied the fossil forms, must have seen the necessity of some kind of subdivision in the genus *Cancellaria*. Until the distinctions in the shells have been supported by some differences in the organisation of the animal, it will be advisable to retain H. and A. Adams' divisions as subgenera.

Considering the fossil forms, the following observations may be found worthy of notice. It will always be very difficult to distinguish between *Cancellaria* proper and *Trigonostoma*, unless the last name is restricted to a very few typical species only. *Aphora* may better not be separated from *Merica*, while this latter and *Euclia*, *Narona*, *Massyla*, and *Admete* may probably for the most part be conveniently separated as genera.

There are about 70 species of *CANCELLARIIDÆ* known living, and about as many tertiary, of which some 50 are neogene and 20 eocene. It is interesting to see that those forms, quoted by Adams under *Cancellaria* and *Trigonostoma*, which are at least five times more numerous than the others in the present seas, are in the neogene period about equal in number to those of the other groups (*Euclia*, etc.), while in the eocene period they form scarcely one-third of all the known *CANCELLARIIDÆ*, and in the cretaceous epoch only about one-fifth. This shows also a development of elongated, conical, non-or scarcely-umbilicated forms into ventricose and largely umbilicated species, a tendency in part similar to that known in the family *VOLUTIDÆ* and some others.

The species which are up to the present known as *Cancellaria* from cretaceous rocks are exceedingly few, and most of them rather doubtful, being known only from imperfect specimens.

Cancellaria.

1. *Canc. obtusa*, Binkh. (Mong. Gast. et. Ceph. 1861, p. 5, Pl. II, Fig. 2) belongs to the type of *Merica*, Adams, having a solid columella and the anterior termination of the aperture barely notched.
- 2.? *Canc. reticulata*, Binkh. (ibid. p. 66, Pl. V^a 2, Fig. 8) remains doubtful, not allowing even the determination of the family with certainty. This and the previous species are from the upper cretaceous deposits of Limbourg.
3. *Canc. Alabamensis*, Gabb (Jour. Acad. Nat. sc. Phil. Ser. II, 1860, IV, p. 301, Pl. 48, Fig. 14).
4. *Canc. Eufaulensis*, Gabb (ibid p. 390, Pl. 68, Fig. 8); imperfectly known; Gabb does not mention even any columellar folds, neither are they apparent in the figure.

Turbinopsis, Conrad, 1860. (Jour. Acad. Nat. sc. Phil. Ser. II, vol. IV, p. 289).

5. *Turbinopsis Hilgardii*, Conr. (ibid Pl. XLVI, Fig. 29).
6. *Turb. (Cancellaria) septemlirata*, Gabb (Proc. Acad. Nat. sc. Phil. 1860, p. 94, Pl. I, Fig. 10).

If there actually be only one columellar fold present the genus *Turbinopsis* ought to be separated from *Cancellaria*, as there are no such forms to be met with among living *Cancellariæ*. It has been proposed by Conrad for the former species and the author states, that there appear to be two or more species of this genus in the cretaceous

rocks of New Jersey, "occurring in the state of casts," etc. From the deficient state of preservation, in which the species of *Turbinopsis* have been found, it is really very difficult to ascertain, whether they belong to this family at all. The spiral striæ, or revolving lines as the American palæontologists usually call them, present in both of the species and the want, or at least non-appearance, of transverse ribs indicates rather a different character of ornamentation, from what is usual in the family *CANCELLARIIDÆ*. I would not be in the least surprised, if the two species were shown to belong to the family *TROCHIDÆ* or *LITTORINIDÆ*, (*Modulus*). We describe in the following pages five species of *CANCELLARIIDÆ* from the South Indian cretaceous beds. In transferring two species, formerly described by Prof. Forbes as *Voluta breviplicata* and *V. Camdeo*, to this family, we do so in accordance with the general habitus of the shell, the character of ornamentation, the anterior position and unequal strength of the columellar folds, and the thickness of the posterior portion of the inner lip. All the Indian *CANCELLARIIDÆ* belong to the upper series of the cretaceous beds, and mostly to the Arrialoor group.

The *Canc. torquilla*, Zekeli, from the Alpine-Gosau deposits must be excluded, being a *Fasciolaria* or possibly a *Latirus*; there are, however, two as yet undescribed species of *CANCELLARIIDÆ* known to occur in the same deposits (*vide* Sitz. Akad. Wien, 1865, LII, Revis, &c., p. 80); and these being included we may fix the number of presently known cretaceous species belonging to this family at thirteen, four being European (one doubtful), four North American (two doubtful), and five South Indian, thus at least approximately showing that the family appears to have been more numerous in the tropical regions during the cretaceous time, precisely as during the present epoch it is nearly exclusively confined to those seas. Only a few species are known from the Mediterranean sea.

XLI.—CANCELLARIA, *Lamarck*, 1799.

1. CANCELLARIA ANNULATA, *Stoliczka*, Pl. XIII, Fig. 11.

Canc. testa ovali, spira brevi-subacuta; ultimo anfractu ventricosso, spira altiore; anfractibus spiraliter striatis, transversim costulatis; striis elevatis, filiformibus, interstitiis latioribus separatis; costulis circiter ternis in uno circuitu crassioribus, varicosis, ceteris tenuioribus atque inter se nonnunquam inæqualibus; columella arcuata, triplicata.

Spiral angle 65°; sutural angle about 10°.

Shell ovate, the last whorl ventricose and largest. There are only about five or six whorls present, and all of them are ornamented with spiral elevated striæ and transverse ribs, exactly similar to those in typical *Cancellariæ*. The spaces between the spiral striæ are broader than the thickness of the striæ themselves, which being crossed by the transverse ribs produce a reticulated surface of the shell. The ribs are, however, always stronger than the striæ, and generally about three of them in

each whorl are much thicker, forming elevated ridges; all frequently cross the whorls obliquely. The embryonal whorls, the outer lip, and the termination of the anterior canal are not perfectly preserved in our specimen, and have been restored in outline in their probable shape. The columella exhibits three oblique strong folds, placed close to each other; the posterior portion of the inner lip does not appear very thick, as the spiral striation of the whorl is pretty clearly perceptible. The columella appears to have had only a somewhat broad fissure at its anterior termination, being solid internally.

Binkhorst's *Cancellaria? reticulata* (Gast. et. Ceph. Limbourg, 1861, p. 66, Pl. V^a 2, Fig. 8), exhibits a somewhat similar ornamentation, but there are no such stronger varices marked by the author, and the transverse ribs appear on the whole to be more numerous.

Locality.—Olapaudy; the figured specimen is the only one yet obtained, and is undoubtedly a great rarity as a cretaceous fossil.

Formation.—Arriallor group.

Euclia, H. and A. Adams, 1853.

The principal character of *Euclia* is said to lie in the want of the umbilicus and the deep notch on the anterior termination of the aperture. Not being well acquainted with the living representatives we prefer for the present to retain the name only as a sub-genus of *Cancellaria*.

2. CANCELLARIA (EUCLIA) BREVIPLICATA, Forbes, sp. Pl. XIII, Fig. 12.

1846. *Voluta breviplicata*, Forbes, Trans. Geol. Soc. Lond. VII, p. 132, Pl. 12, Fig. 7.

1850. *Fusus breviplicatus*, D'Orbigny, Prod. II, p. 230, *idem*, Gabb, &c.

(*Eucl.*) *testa ovata, apice acuminata, spira brevi, vix quartam partem totius altitudinis formante, ultimo anfractu ventricosus; anfractibus quinque, primis duobus laevigatis, ceteris transversim. costulatis, infra suturam canaliculatis; costulis obliquis, in canali atque ad medium ultimi anfractus obsoletis; superficie spiraliter minute sulcosa, sulcis ad terminationes anfractuum solum distinctioribus, inter se inaequidistantibus atque inaequalibus; apertura ovata, postice acuta, subcanaliculata, antice truncata, effusa; labio postice valde calloso, margine columellari recto, biplicato, plica antica obliquiore.*

Spiral angle 75°; sutural angle 11°.

Height of last whorl : total (considered as 1·00) ... 0·76.

The ventricose shell with a short, pointed spire, the short and very oblique ribs, being obsolete posteriorly below the suture and on the convexity of the last whorl are very characteristic distinctions of this fine species. Originally the entire shell, which is markedly solid, appears to be covered with impressed lines, remaining, however, more distinct and placed closer to each other only near the suture and on the anterior portion of the last whorl, where they are also of unequal width. Prof. Forbes speaks of 'two deep sulcations', but there is certainly only one

principal constriction of the whorls, as is also distinctly seen in his figures; but while there are usually two impressed lines in this sulcation, close to each other, there is often a third line seen above it, and it could only have been this to which Prof. Forbes refers as the second sulcation. On the upper volutions there is generally nothing seen of the impressed lines, the deeper sulcation only remaining visible.

The posterior portion of the inner lip is very much thickened, smooth, and separated from the equally thick outer lip by a narrow channel. The columellar portion of the lip exhibits two strong folds, the anterior of which is more oblique; they were not visible in Prof. Forbes' specimen, although he suspected their presence, and in that was undoubtedly more correct than D'Orbigny, who might rather have called the species a *Buccinum*, but not a *Fusus*, to which it has barely a resemblance, even in an imperfect state. The anterior emargination of the aperture is externally indicated by two sharp ridges, which mark its former limits, the lower one being more rounded.

Locality.—Comarapolliam, N. of Arriallor; only a few specimens have as yet been found. Prof. Forbes' specimens are said to be from Pondicherry.

Formation.—Arriallor group.

3. CANCELLARIA (EUCLIA) INTERCEDENS, *Stoliczka*. Pl. XIII, Fig. 13.

(*Euc.*) *testa ovate-elongata, spira brevi; anfractibus quinis, lente convexis, transversim costulatis, prope suturam constrictè canaliculatis; costulis prope rectis, numerosis (15—30 in uno circuito), lævibus, in ultimo anfractu infra medium evanescentibus; parte anteriori ultimi anfractus spiraliter impresse-lineato; apertura elongata, semielliptica, ad marginem interiorem prope recta; labro arcuato, tenui, labio postice calloso, antice buplicato; canali extus atque supra acute-marginato.*

Spiral angle 70°; sutural 10°.

Height of last whorl : total (considered as 1·00) 0·71.

This species is intermediate between *C. breviplicata* and *Camdeo*; it has the habitus of ribs and of the whorls of the first, but the great number of ribs and the elongated form of the latter. There are only five volutions present, and the two uppermost are smooth; along the suture there is only one broad sulcation, but this is placed much nearer to the suture than in *Euc. breviplicata*, as will be better seen by a comparison of the respective figures. The transverse ribs amount on the last whorl to 30, and they become obsolete, after they have passed the middle of the whorl, where the spiral striation begins. The upper ridge, indicating and bounding the anterior notch exteriorly, is especially strong and sharp. The inner lip is thickened posteriorly, and has in front two oblique folds, being comparatively much thinner than in *Euc. breviplicata*.

Locality.—Comarapolliam, where a few specimens have been procured with the two other species of *Euculia*.

Formation.—Arriallor group.

4. CANCELLARIA (EUCLIA) CAMDEO, *Forbes, sp.* Pl. XIII, Fig. 14.1846. *Voluta Camdeo*, Forbes, Trans. Geol. Soc. Lond. VII, p. 131, Pl. XII, Fig 5.*idem* D'Orbigny, Gabb, Pictet, etc.

(*Euc.*) *testa ovale-elongata, cylindracea; anfractibus senis, subplanis, gradatis, primis duobus lævigatis, cæteris transversim dense costulatis; costulis acutis lævigatis, postice ad suturam celeriter multo tenuioribus atque duabus lineis impressis intersectis; spira brevi, tertiam partem totius altitudinis formante; ultimo anfractu antice valde constricto, spiraliter impresso lineato; apertura oblonga, antice late effusa; labro ad marginem attenuato, antice intus lævigato; labio postice incrassato, calloso; columella recta, solida, triplicata, plica media crassissima; canali antice late emarginato, extus lineis tumescentibus acutis utrinque notato.*

Spiral angle 65°; sutural angle 15°.

Height of last whorl : total height (considered as 1·00) 0·68.

The general form of the shell is cylindrical, being narrowed towards each end, more so on the spire, which measures only one-third of the total height. The uppermost two embryonal whorls are smooth, the following densely covered with smooth, acute, transverse ribs, being quite straight or parallel to the axis, indicating the height of the shell. There are 25 of those ribs on the last whorl, but their number is considerably less on the upper whorls, decreasing to only 12 on the fourth last, or the first on which the ribs appear. Along the suture the whorls are suddenly much contracted, and the ribs become thinner, being crossed here by two spiral furrows, closer to each other, than to the margin of the suture, so as to form on this small tubercles. Similar impressed lines or furrows are seen on the anterior portion of the last whorl, where it begins to become narrower.

The aperture is elongated, ovate, anteriorly broadly emarginated, which emargination is marked exteriorly by a broad furrow, exhibiting curved lines of growth and bounded on either margin with sharp swellings. The outer lip has a sharpened edge and interiorly, so far as is visible on a preserved anterior portion, it is smooth. The inner lip is posteriorly much thickened, callose, and smooth; anteriorly on the columellar portion it is straight, and bears three folds, the middle one being the strongest and the anterior more oblique than the two previous ones, of which the last is again more oblique than the middle one.

This singular fossil shell, to which the two other species of the genus here described are the only similar forms known, has been described by Prof. Forbes as a *Voluta*, but the general habit of the solid shell, the thickening of the inner lip, the folds and the canal scarcely leave a doubt that it belongs to the family of the *CANCELLARIIDÆ*, and in having a solid columella and a broad canal emarginated at the termination it can be only placed in the sub-genus *Euculia*. D'Orbigny seems to have already noticed some peculiarity in Forbes' species, because he added a query to the name, when quoting it in the Prodrôme, II, p. 226, although the query appears rather to refer to the species than to the genus.

Locality.—Comarapolliam; only the single figured specimens has been found here. Prof. Forbes gives the locality Pondicherry.

Formation.—Arrialoore group.

XLII. NARONA, *H. and A. Adams*,

is distinguished by a much produced canal with attenuated termination, two principal columellar folds and crenulated margin of the outer lip; the forms united by *H. & A. Adams* under this name being very peculiar and different from the other sub-genera of *Cancellaria*, we do not hesitate to accept the same as a genus.

1. NARONA (CANCELLARIA) EXIMIA, *Stoliczka*, Pl. XIII, Figs. 15 and 16.

Nar. testa ovata, spira brevi, acuminata; anfractibus quinis, convexis, duobus primis minimis, lævigatis, ceteris lineis spiralibus impressis atque costis transversalibus, crassis ornatis; lineis æquidistantibus, numerosis, interstitiis latioribus separatis; costis inter se æqualibus, rectis, circiter duodenis in uno circuitu; apertura obliqua, elongate-ovata, utrinque ad terminationes subacuta, antice effusa; marginibus paulo incrassatis, labro intus ad marginem crenulato, postice parum insinuato; labio valde calloso, arcuato, antice biplicato, postice uniplicate-dentato; canali moderate prolongato, lateraliter quoddam curvato.

Spiral angle 70° — 80° ; sutural angle 7° — 8° .

Height of last whorl : total of shell (considered as 1.00) ... 0.69—0.76.

This very fine shell consists usually of five strongly convex volutions, the last of which is always the most inflated, the height of the spire varying from 24 to 31 hundredths of the total height of the shell. The two uppermost whorls are very small, flattened (not inflated as usually in species of the *VOLUTIDÆ*), but smooth; the others are spirally sulcated and transversally ribbed. The sulci, or rather only impressed lines, are separated by interspaces, broader than their own width, while the same are between the transverse ribs very nearly equal to the thickness of the latter. The great regularity in the ornamentation, combined with the peculiar form of the shell, appear to be very constant characters of this species.

The aperture is placed obliquely to the axis of the shell, ovate, being pointed on each end and provided anteriorly with a notch in consequence of the prolonged canal; both margins are posteriorly united; the outer sharpened on its edge, thickened interiorly and denticulated, having near the posterior termination a slight sinuosity, although this barely affects the straightness of the transverse ribs; the inner lip is in its entire extent much thickened, posteriorly somewhat expanded with a short fold on the inner side, and anteriorly with two equal but not strong, very oblique, folds, which extend over the entire columella; the latter is solid; the canal produced, somewhat laterally bent, and very slightly recurved. This last peculiarity of the produced canal, the great thickness of the inner lip with two anterior equal folds, and the short posterior fold, as well as the solid structure of the shell bear decidedly a more striking resemblance to the *CANCELLARIIDÆ* than to the *VOLUTIDÆ*, to which otherwise this species could be referred.

The only fossil which I am aware of, and which, as regards its general form, bears some resemblance with our species is *Voluta Melo*, Schafhäutl (*Süd-Bayerns Leth. geognostica* 1863, p. 203, Pl. XLIX, Fig. 5). The specimen is said to have been

imperfect, and no columellar plaits are referred to either in the figure or in the singular description of the author. The locality and geological position are equally unknown; and most probably will remain so unless somebody else rediscovers the fossil and settles these points.

Localities.—Alundanapooram and Ninnyoor in Trichinopoly; at the former locality, which belongs to the Trichinopoly group, the species is not rare, but at the other locality only a single specimen has as yet been found. It is a small specimen and also somewhat slender, but it certainly does not belong to *Lyria formosa* (p. 97), which at the last locality in the same white limestone is pretty common. The ribs are not intersected near the suture by spiral sulcations, as they are in that species of *Lyria*.

Formation.—Trichinopoly and Arrialoor groups.

XVII. Family—TEREBRIDÆ.

(Vide H. and A. Adams' Genera I, p. 223; *ACUSIDÆ* and *PUSIONELLADÆ*, Gray, Guide, 1857, pp. 5 and 22; *TEREBRIDÆ* and *PUSIONELLIDÆ*, Chenu's Manual, I, pp. 218 and 221).

The animals of the *TEREBRIDÆ* have a small foot, the mantle enclosed, and the siphon more or less prolonged. The proboscis is occasionally strong, thick, and entirely retractile, sometimes, however, very short or even rudimentary. The teeth, so far as known from a few species, resemble those of *Conus*: they are subulate, elongate, and arranged in two series; in other species, however, no teeth have been discovered at all. The same is the case with the tentacles, which when present or at least externally traceable, are short, thick at the base, and close together on the side of the mouth or proboscis. The eyes are externally near the end of the tentacles, or within their length, or near the basis; sometimes they are said to be wanting.

The operculum is horny, ovate, and lamellar. The turreted shells are always distinguished by their solid structure, *more or less polished surface, and a large number of volutions*. The mouth is either abrupt with a notch in front, or extended into a canal of moderate length; the outer lip is sharpened, not thickened exteriorly; the columella often more or less twisted, sometimes with one or two distinct folds, placed in a manner similar to those in several *CERITHIIDÆ*.

Hörnès gave, in his Mollusca of the Vienna basin (Abhandlungen Geol. Reichs-Anst. Wien, Vol. III, p. 125), a few practical hints how to distinguish imperfect specimens of *Terebra* from *Turritella*, *Cerithium* and others, but it is not clear in what way he thinks a sub-division of *Terebra* practicable according to the differences in the spiral angle (vide *ibid*, p. 127).

H. and A. Adams propose to divide the family *TEREBRIDÆ* into two sub-families, *PUSIONELLINÆ* and *TEREBRINÆ*. The former is subsequently (Genera, II, p. 656) referred to the *BUCCINIDÆ*.

The *PUSIONELLINÆ* (*PUSIONELLADÆ*, Gray; *PUSIONELLIDÆ*, Chenu) are represented by one genus only, *Pusionella*. They are turreted or ovately elongated porcellaneous shells, with smooth polished surface, a tolerably produced anterior

canal, and a slightly twisted columella. The operculum is obovate, with a central, lateral, and internal nucleus. The animal does not seem to have been made known up to the present. It is possible that acquaintance with it may support Adam's subsequent proposition, which remains only a question of time. I would, however, draw attention to the similarity of the shells and operculum of *Pusionella* with those of the *CLAVATULINÆ*, a sub-family of the *PLEUROTOMIDÆ*. The general form of the shells does not exhibit any particular difference. Several of other *PLEUROTOMIDÆ*—*Mangelia* and *Cythara*,—have a totally similar structure of the shell, to what we find in *Pusionella*. The *Pusionella Nifat*, *P. scalarina*, and others have a distinct notch near the suture on the outer lip, and in all cases the posterior portion of the aperture is somewhat contracted or narrowed. The opercula are exactly the same in *Pusionella* and *Clavatula*, and it would not therefore be the least surprising if the animals would show us, that *Pusionella* belongs to the *CLAVATULINÆ*.

In the other sub-family—*TEREBRINÆ*—Messrs. Adams distinguish two genera, *Acus*, Humphrey, and *Terebra*, Adanson. If the animals were throughout so different as they are represented by the two typical forms in Adams' Genera, it would be worth while to support these genera by some distinctions in the shells. But the former distinction as regards the position of the eyes does not seem always to exist, and the latter, relating to the existence of a posterior sutural groove, tortuous columella, and anteriorly sinuated outer lip of *Terebra* as distinct from *Acus*, is almost impossible to retain. If these distinctions are to be really of any great importance, it appears as if we should then occasionally regard specimens unquestionably belonging to one and the same species as not only specifically, but even generically different. We should besides form a number of other small groups or sub-genera to receive those species which have a sutural band but no anterior sinus on the outer lip, and those which have a twisted columella and the same entire outer lip, both being distinct from *Acus* proper; otherwise we had better not have entered at all upon a division of the genus *Terebra*. Gray rejects (Guide, 1857, p. 6) Messrs. Adams' distinctions as to *Acus* and *Terebra*, uniting both under the former name. He adds, however, three other genera, *Subula*, *Leiodomus*, and *Dorsanum*, the last of which seems scarcely different from *Bullia*. The animal of *Leiodomus* is sufficiently different from *Terebra* and from *Bullia*, but it is very difficult to distinguish the shells from the latter. Speaking of *Subula*, Dr. Gray refers to some figures (of Quoy and Gaimard in Mrs. Gray's collection) which contradict his own characteristics. From all these remarks it will be sufficiently clear that we must wait for some time until the examination of the animals of *Terebra* has so far advanced as to support any proposed distinctions in the shells.

It remains finally to say a few words as regards the place which we have assigned here to the *TEREBRIDÆ*. We confess that it was almost accidental that the family has been treated here, because we could not find any other better or more appropriate place for it before. The natural relations to the *CANCELLARIIDÆ* on the one and to the *PYRAMIDELLIDÆ* on the other side would scarcely have called

for a separate explanation on our part had we not seen the subject of classification dealt with so very severely elsewhere. (Vide Deshayes' *Anim. s. vert. bass. de Paris*, 2nd edit., vol. II).

The *CANCELLARIIDÆ* are classed by H. and A. Adams in the so-called *ROSTRIFERA*, by Gray in the *PROBOSCIDIFERA*, but in both cases far apart from the *TEREBRIDÆ*, which are acknowledged to belong to the *TOXIFERA*, in the vicinity of the *CONIDÆ* and *PLEUROTOMIDÆ*. When we compare the animals of the *CANCELLARIIDÆ* with many of the *TEREBRIDÆ*, we find that both agree in the small foot; short tentacles, thickened at the base; sessile eyes on the outer base of the tentacles; usually in the presence of a short proboscis, and in the occasional want of a lingual membrane and teeth. I am not aware in how many species of *Cancellaria* the teeth have been examined, but Troschel says that the teeth of *Cancellaria* resemble those of *Comus*. Even if this is really throughout the case, all the similarities between the two families, the *CANCELLARIIDÆ* and the *TEREBRIDÆ*, cannot be sacrificed to the one single difference that *Terebra* has usually a prolonged siphon. Many of the fusiform shells of *Cancellaria* are not by any means so very different, that they could not be looked upon as transitional forms to *Terebra*, and they have also a short siphon. The only thing which could be done in an extreme case and which may actually have good reason, is to place both the families after the *Conidæ*, in which case the *CANCELLARIIDÆ* would form a transition to the *VOLUTIDÆ*.

Originally the *TEREBRIDÆ* were placed by H. and A. Adams immediately before the *PYRAMIDELLIDÆ*. There does not seem in fact to exist such a great difference between the animals of *Terebra* and *Pyramidella*, as generally supposed. The form of the foot, short head, proboscis and tentacles, generally unarmed tongue, or rudimentary teeth, are certainly, as already stated, very like in both. The differences consist in the foldings of the tentacles, the internal position of the eyes in *Pyramidella* and the prolonged siphon in *Terebra*. As regards the form and structure of the shell there is certainly no other group of Mollusca more related to many fossil *PYRAMIDELLIDÆ* than most of the recent *TEREBRIDÆ*. The fossil species of *Nerinea* and others, which certainly have their recent representatives in *Pyramidella* and *Obeliscus*, are thus most closely allied to the *TEREBRIDÆ*, so that to make a distinction between them is sometimes almost impossible, even among better preserved specimens. I do not understand why Mr. Deshayes should so very much regret that H. and A. Adams did not state particularly their reasons for having placed the *TEREBRIDÆ* before the *PYRAMIDELLIDÆ*. (Vide *An. sans vert. Foss. bas. de Paris*, Vol. II, pp. 529 and 530, and Vol. III, pp. 513 and 514.) I am rather more surprised that those conchologists who refer *Terebra* to the *BUCCINIDÆ*, have not thought it necessary to explain their reasons for doing so. They have, it is true, the authority of Lamarck, Quoy and Gaimard, but with those authorities they seem to have remained contented. Lamarck predicted the relation of *Terebra* and *Buccinum* (*Nassa*?) from the supposed similarities of the shells, in which he was evidently supported by referring several species of *Northia* and *Bullia* to *Terebra* and *vice versa*. Certainly

there are several species of *Terebra*, which greatly resemble some species of the *BUCCINIDÆ*, but the largest number is decidedly more allied to the *PYRAMIDELLIDÆ* or even to the *MITRINÆ* of the *VOLUTIDÆ*.

Quoy and Gaimard, when they made known the animal of *Terebra*, stated—perhaps guided by Lamarck's suggestion—that this genus has to be classed close to *Buccinum*. (Vide Voy. d. Astrolabe, Zoologie, Vol. II, p. 461, Atlas, Pl. XXXVI). Further on the authors note the great relations of the animal of *Terebra* and *Mitra*, and state even that, in case any operculated *Mitræ* are found, the passage between both would be so great, as to make a distinction almost impossible. The animals of the *TEREBRIDÆ* are no doubt more like those of the *MITRINÆ* than those of the *BUCCINIDÆ*. It appears to me, when comparing the animals of *Terebra* with those of *Nassa*, *Phos*, *Bullia*, and others, that they have nothing more in common with each other than the elongated siphon; the examination of the teeth showed equally a great difference between both families. On what ground, therefore, the *TEREBRIDÆ* ought to be classed with the *BUCCINIDÆ* I am at a loss to perceive. We do not wish in the least to enforce the idea, that the *TEREBRIDÆ* are correctly classed next to the *PYRAMIDELLIDÆ*, but we confess that upon looking over the extensive number of fossil species of the latter family, we are at the present unable to assign for them a better place.

The *Terebræ* live generally near the low water-mark, and are to be found in greatest variety in the eastern tropical and sub-tropical seas. Reeve described, 1860, in his last Monograph of *Terebra* 155 species, after rejecting some of the new species of Hinds and Deshayes, published in previous Monographs of the same genus. Since 1860 a few new species have been described in the Journal de Conchyliologie; Proc. Zool. Soc.; and elsewhere, so as to bring up the number of living *Terebra* to about 170 species.

There are from the tertiary deposits about 30 species of *Terebra* (*Acus*) quoted, some of which occur also living. A large number comparatively is known from America. Already in the eocene beds *Terebra* becomes very scarce, and, as regards the cretaceous, Prof. Pictet properly remarks that no species of *Terebra* are there known with certainty. (Vide Mat. Pal. Suisse, ser. III, p. 677.)

The *Terebra coronata*, Sow., from the Alpine Gosau-deposits—*Cerithium pseudocoronatum*, D'Orb., is probably a *Tympanotonos*, in which case the change in the specific name would not be required.

The *Terebra minuta*, Galeotti, from Mexico is called by D'Orbigny *Cerith. sub-minutum*.

Terebra obconica, Sharpe, from Portugal has the form of *Terebra*, but the specimens upon which it was founded appear fragmentary of the aperture and with the surface worn off, although the description does not refer to either. The columella is not twisted.

The name *Terebra cingulata*, in Giebel's Petref. Deutsch., p. 481, refers to *Fusus cingulatus*, Sow., from the Gosau (Zekeli's Gastropoden der Gosaugebilde, p. 91, Pl. XVI, Fig. 7, in Abhandlung. der Geol. Reichs-Anst. 1852, Vol. I). Dr. Zekeli considered the species first as a *Terebra*, but retained afterwards Sowerby's determination. I have in my revision (Sitzb. Akad. Wien, 1865, vol. LII, p. 83) remarked, that the species may not unlikely be proved to be a *Terebra*, although it has not a tortuous columella, but a distinct sutural band. No perfect specimens have been as

yet observed. The remains of stronger varices at shorter or longer distances would, on the other hand, rather speak against a *Terebra*, and would be more in favor of a species of the *CERITHIIDÆ*.

We have nothing to add from the South Indian cretaceous deposits.

A few jurassic species have been described as *Terebra*, namely, *T. melanoides*, Phillips (Yorkshire, 1829, p. 102, Pl. IV, Fig. 13), *T. granulata*, Phill. (ibid Pl. VII, Fig. 16), and the *T. Portlandica*, Sow. (Trans. Geol. Soc. Lond. IV, p. 349, Pl. XXIII, Fig. 6). None of these is certain; the first was referred by D'Orbigny to *Chemnitzia*; the second by Lycett (Supp. Monog. of Moll. etc. 1863, p. 10, Pl. XXXI, Fig. 12) on account of a single columellar fold (this would not prevent its being a *Terebra*) to *Nerinea*, and the third by D'Orbigny to *Cerithium*.

XVIII. Family—PYRAMIDELLIDÆ.

Under this name we retain most of the typical forms of *Pyramidella*, *Obeliscus* and others, as stated by H. and A. Adams, and add to these the numerous fossil species known commonly under the name of *Nerinea*.

The characteristics of the family may be put thus:—

Turreted or broadly conical shells, with usually sinistral apex and the aperture anteriorly effuse, obsoletely notched, or produced into a shorter or longer canal; inner lip generally, outer lip occasionally, plaited.

The opercula of the living genera are narrow, elongated, horny, sub-spiral, with a notch on the internal side. The animals have a small foot without or with a small operculiferous lobe, short and anteriorly folded tentacles, which are thickened at the base, and have the eyes on the internal edges near the basis, sessile or on thick bulgings. The teeth are said to be wanting or rudimentary. The proboscis is figured by Quoy and Gaimard (Voy. Astrolabe, Atlas Pl. LXVII) trumpet shape, of a form very similar to that of *Terebra* (ibid. Pl. XXXVI, Fig. 17). The mantle is generally provided with a distinct siphonal fold. Some of the living animals, of *Obeliscus* at least, must have a short produced siphon and turned upwards, otherwise it would be impossible that such a distinct ridge with insinuated striæ of growth could be formed at the anterior termination of the last whorl, as can generally very distinctly be observed in *Obeliscus*, and in *Pyramidella* very often also. On this account, supported by the well developed anterior canal in the fossil *Nerineæ* (and thus allowing a conclusion as to a relatively greater development of the siphon), we think it advisable to retain this family in the SIPHONOSTOMATA, as long as this latter tribe of CTENOBANCHIA cannot easily be replaced by some better arrangement.

It is true that the genera *Odostomia*, *Turbonilla*, and others can in no way be sufficiently characterized as SIPHONOSTOMATA, but according to what is known about the animals of all the different genera, they appear to be so thoroughly identical, that it is impossible to keep them separate. There is, as I have already mentioned, some kind of disharmony and evident insufficiency in every systematical attempt.

Pictet offered some able remarks on the *PYRAMIDELLIDÆ* in his Mat. p. 1. Pal. Suisse, 3me. ser., p. 214, and still more Deshayes in his recent edition of the Paris fossils, Vol. II, p. 527. Both are disposed to retain the family as it had been delineated by Gray in his Guide of 1857, p. 57. Forbes and Hanley say very properly of this family "rather as appertaining to past ages than the present epoch." (Hist. Brit. Moll. Vol. III, p. 217.) Deshayes (loc. cit. Vol. II, p. 529) remarks also that the extensive genus *Nerinea* ought to form a distinct family from the *PYRAMIDELLIDÆ*, with which we cannot agree for a moment. The shells of the largest number of *Nerineæ* are not only totally alike to those of *Pyramidella* and *Obeliscus*, but it will be and is indeed, almost impossible to separate exteriorly some *Nerineæ* from *Obeliscus*.

The last Monograph of *Pyramidella* by L. Reeve (Conch. Icon., pt. 250 and 251, 1865) contains the descriptions of 45 species, but some of them belong to *Syrnola*, *Monoptygma*, and others. Perhaps there are scarcely more than 30 which may be retained as *Obeliscus* and *Pyramidella*.

The tertiary species scarcely amount to 20, of which more than half are eocene. Deshayes described lately eight; Morris indicates three from the English eocene, and a few are noted from America. Scarcely a single species of the group of shells, known as *Nerinea*, has been reported from tertiary beds.

Before we enter upon the cretaceous fauna, it will be probably useful to give first a short review of the genera which belong to the family *PYRAMIDELLIDÆ*, and we begin, thus, first, with living forms.*

1. *Pyramidella*, Lamarck, 1796.—Shell turreted, conical or ovate; whorls transversally ribbed; columella usually solid, with three oblique plaits, the posterior of which is the largest; outer lip generally thickened externally, smooth internally; aperture anteriorly effuse and obsoletely notched.

There have been up to the present only eight or nine species described—all from the eastern seas,—but several new species have been discovered since by A. Adams.

2. *Obeliscus*, Humphrey, 1797.—Shell turreted, elongated; whorls smooth and polished; columella usually hollowed out, with two or more oblique plaits; outer lip internally often striated, and with remaining internal varices at some distances; the margin sharpened or somewhat expanded; aperture in front distinctly produced into a short canal and often notched at its termination. The living species of *Obeliscus*, which amount to 20 or 21 only, are also chiefly inhabitants of the eastern seas, although a few are known from the West Indies.

* I have published some provisional notes on the genus *Nerinea* in the Sitzungsber. d. Akademie, Wien, Vol. LII, 1865 (Revision d. Gastropoden, etc., p. 24), and I have since been anxiously looking for a collection of fossil Gastropoda, which was ordered from Europe for our Museum. Unfortunately the lamented death of Mr. L. Semann in Paris caused a delay in the despatch of this collection, and we shall have to wait now a little longer, until some of the desirable comparisons and examination of fossils can be carried out. On this account I would not like to go farther into the examination of the *Nerineæ*, than to point out a few generic types by a reference to already well known fossils. It would not be advisable in every case to propose names for them; a delicate question of this kind ought not to be settled upon mere figures of mostly incomplete specimens.

These two genera are usually treated by conchologists under the more general name of *Pyramidella*, and under this name there have been a few cretaceous species noticed. Strictly speaking, there is, however, from cretaceous beds not a single species known which corresponds exactly with the living and tertiary species of *Pyramidella** or *Obeliscus*, unless it be the *Pyramidella æquiplicata*, which name has been proposed by Deshayes for a species figured by Walch in the "Naturforscher," Halle, 1774, Vol. I, p. 204, Pl. III, Fig. 3, a publication to which I am for the present unable to refer.

3. *Monoptygma*, Lea, 1833 (H. and A. Adams' Gen. I, p. 234).

3, a. *Menestho*, Möller, 1842.—This sub-genus quoted by H. and A. Adams (*ibid.*) is subsequently acknowledged by A. Adams as a good genus, although it hardly appears to be sufficiently characterized (Ann. Mag. Nat. Hist. 1861, ser. 3, Vol. VII, p. 296).

3, b. *Odostomia*, Flem., 1848 (H. and A. Adams' Gen. I, p. 232) includes the species with somewhat shorter spire and inflated last volution; the surface is smooth and polished in typical forms.

3, c. *Syrnola*, Adams, 1860 (Proceed. Zool. Soc. Lond., 1862, p. 233); *shell subulate, turreted, polished, whorls smooth, plain; aperture oblong; inner lip with an oblique fold in the middle; outer lip sharp*. The anteriorly ovate aperture and the presence of only one fold on the inner lip distinguished this genus from *Obeliscus*, to which it is otherwise a closely allied form.

3, d. *Styloptygma*, Adams, 1862 (Proc. Zool. Soc. Lond., 1862, p. 235) contains a number of species of *Syrnola*, which are inflated about the middle of the spire, somewhat of the shape of a *Pupa*, *Clausilia* or *Colina*; the whorls are smooth or slightly ribbed.

3, e. *Chrysalida*, Carpenter, 1858 (H. and A. Adams' Gen. II, p. 622) are also pupiform shells, with usually a cancellated surface and one columellar plait; aperture contracted, peristome continuous.

3, f. *Amathis*, A. Adams 1861 (Ann. mag. nat. Hist. VIII, p. 303), is another form with one posterior fold.

4. *Elusa*, Adams, 1861 (Ann. Mag. Nat. Hist., 1861, 3rd, ser. Vol. VII, p. 297, and Proc. Zool. Soc. Lond., 1862, p. 237). Mr. A. Adams has proposed this name for the elongated, turreted species of *Turbonilla* with transversally plicated whorls and one columellar fold; it appears advisable to retain this genus.

* Schafhäutl (Letheæ Geog. Süd-Bayerns, 1863, p. 387, Pl. LXXIV, Fig. 3) notices a *Pyramidella tornatilis*, D'Orb., although I am unable to find the reference. I would not be surprised if the author wished to designate *Actæon tornatilis*, Montf. and confounded both names, as in the case of *Actæon Vibrayana*, D'Orb., which he evidently quotes on the next page as "*Actæonella Vibrayana*., D'Orb." The species above referred to is quoted from the same beds as *Pyram. canaliculata*, D'Orb., and would be therefore a cretaceous fossil, but I am afraid the one determination is quite as little to be depended on as the other.

5. *Turbonilla*,* Leach, 1826 (? 1819) (H. and A. Adams' Gen. I, 230).—It is known that, when Risso first introduced the name *Turbonilla* of Leach, he described under it species with and without a columellar fold. Several conchologists, and among them Deshayes in his last edition of the Paris fossils, retain the genus in the same sense as Risso, others have proposed distinctions in various ways. The name *Turbonilla* was consequently applied to species with a fold, while others without the same have been referred to *Chemnitzia* of D'Orbigny. Again, the names *Turbonilla* and *Chemnitzia* were considered as identical by Gray, Deshayes and others and this once admitted, another time the other name is allowed to have priority. In many works on recent conchology the name *Turbonilla* was reserved for the non-plicated species only, and the confusion would be probably cleared up in the easiest way, if the genus was retained in the sense as introduced by H. and A. Adams in their Genera. *Chemnitzia* as subsequently commented on by D'Orbigny (in his Pal. franç. terr. jur.) must be kept thoroughly distinct. The name was founded first upon a plicated *Turbonilla*, for which A. Adams proposes now the name *Elusa*; there is therefore, strictly speaking, no reason whatever to regard *Turbonilla* and *Chemnitzia* as identical. We shall speak subsequently of the latter genus in the family *EULIMIDÆ*.

6. *Eulimella*, Forbes, 1846 (H. and A. Adams, Gen. I, p. 233).—According to the account given of the animal, this genus, like *Turbonilla* itself, cannot be excluded from the family *PYRAMIDELLIDÆ*. The whorls have in fact the typical squarish shape, with flattened, not produced basis, as is invariably the case in *Chemnitzia*.

6a. (*Aciculina*),† Deshayes, 1861 (Paris foss., 2nd edit., Vol. II, p. 530). By this name have been called a few cocene species which differ from *Eulimella* by a greater convexity and perhaps a larger number of whorls. The (*Aciculina*) *emarginata*, Desh. (loc. cit. p. 533, Pl. XXV, Figs. 25—27, not 26—28) is a *Chillia*, and the other species may be regarded as transitional forms to those smooth species of the *CERITHIOPSIDÆ*, which H. and A. Adams called *Alaba*.

Of all these generic forms noted under numbers 3—6 not a single species has yet been fully ascertained to occur in cretaceous strata, although a large number of species are known from the cocene and neogene beds. It is, however, very probable that when more attention has been paid to those little shells, they will not be found wanting in the mezozoic formations. The only cretaceous species of *Odostomia* will be described subsequently from our South Indian cretaceous deposits. The cretaceous *Turbonillæ*, described by Conrad (Journ. Acad. Nat. Sc. Phil. iv) are referred by Gabb in his 'Synopsis of cretaceous fossils' to *Chemnitzia*, which appears in general correct, but a few species like *Turb. Spillmani* are undoubtedly more allied to *Turbonilla* than to *Chemnitzia*.

* *Dunkeria*, Carpenter, 1858 (H. and A. Adams' Gen. II, p. 622) has been proposed as a sub-genus for certain forms of *Turbonilla* with *tumid and cancellated whorls*, but it is considered by A. Adams as more allied to *Aelis* and we shall notice it, therefore, in the *EULIMIDÆ*. The species are mostly from Mazatlan.

† This name has been already, in 1853, used by H. and A. Adams (vide Gen. I, p. 121) as a sub-genus of *Nassa*.

7. Nov. gen.—*Pyramidella involuta*, Müller (Petref. Aach. Kreideform. II, 1851, p. 9, Pl. III, Fig. 10) is rightly quoted by Pictet as a doubtful species. The author says that it is based upon a complete specimen, although the figure does not show this. I am not acquainted with any *Pyramidella* or *Obeliscus* which have the spiral striation or rather ribbing so distinct as this species, and if it really belongs to this family—for Dr. Müller does not mention any columellar plaits—it could in conjunction with two species, described by D'Orbigny as *Nerinea Marrotiana*, and *perigordina* (Pal. franç. crét. II, Pl. 163 bis.), probably be conveniently separated into a distinct genus. A closely related form among living shells would be perhaps *Fastigiella*, Reeve, which has, however, a distinct recurved canal and a somewhat expanded outer lip, for which reason it has been transferred to the *CERITHIIDÆ*. The forms called by A. Adams *Scila* are also spirally striated, but have no columellar plaits, and have been therefore placed in the *CERITHIOPSIDÆ*.

8. *Itieria*.—Matheron proposed (Bull. Soc. Geol. XIII, p. 493) this genus for a species subsequently described and figured by D'Orbigny as *Nerinea Cabanetiana* (Pal. franç. terr. jur. II, p. 99, Pl. 255, Fig. 4, and Pl. 256), and I believe the genus ought to be restricted to forms like this species only. The characteristics can be put thus:—

Shell ovately elongated, with longer or shorter subconical spire; last volution ovate or cylindrical, anteriorly convex and posteriorly partly enveloping the previous whorls; aperture prolonged, narrowly compressed, or ovoid with 1-3 folds on the inner lip, and usually one fold about the middle portion of the outer lip, anteriorly with a narrow and slightly prolonged canal, producing a sharp edge on the termination of the hollow columella, and being continuous and distinctly traceable on the basis of the last volution.

The surface of these shells is usually smooth or transversally ribbed. The columella, which appears to be invariably hollowed out, is usually provided with only two folds and the outer lip with one, although the latter seems to be often present only during a certain stage of life. We may quote a few of the principal species, to which we would restrict Matheron's name; *Itieria* (*Nerinea*) *Cabanetiana*, *Moreana*, *fusiformis*, *Clymene*, *pupoides* and *Mosæ*, described by D'Orbigny in Pal. franç. terr. jur. II; *Ner. tornatella*, Buvignier; perhaps the *Ner. Staszycii*, Zechschner, sp. (Sitzungsb. Akad. Wien, 1855, Vol. XVI, p. 350); farther the cretaceous species, *Nerinea cyathus*, *Meriani*, *rostrata*, Pictet et Campiche in Mater. p. 1., Pal. Suisse, ser. III; *Ner. Bauga*, D'Orb; *Itieria abbreviata*, Phil. sp. (Sitz. Akad. Wien, LII, 1865; Revision of the Gosau Gastropoda, p. 41) and some others.

The principal differences of this genus from *Nerinea* lie in the ovate form of the last volution and in the form of the anterior termination of the aperture. These two characters agree perfectly with *Obeliscus*, and if there were numerous short small folds on the inner side of the outer lip, as they are usually exhibited in the living *Obeliscus*, there would be absolutely no possibility of distinguishing these fossil species from the last named genus.

I am not aware whether the forms, which I have quoted as *Itieria*, possess a sutural band like *Nerinea* proper; none of the figures show it distinctly. I am quite at a loss for the present where to place the two jurassic species, *Nerinea Mandelslohi*, Bronn, and *N. gradata*, D'Orb. If they do not, however, possess a sutural band, I do not think that they can be rightly excluded from the genus *Itieria*. Matheron instituted his genus, as I have already mentioned, only for the one species, *Ner. Cabanetiana*; but if we compare with this, for instance, the *Ner. pupoides*, it becomes evident that there is apparently no other important distinction between those two, than that the latter has one additional plait on the inner lip. We know, however, from species like *Itieria abbreviata* and others that this second fold is like the one on the outer lip, sometimes present, and in other cases wanting. In some other species there seem to be three plaits present, as in typical *Obeliscus*; we cannot therefore give the existence and number of these plaits an absolute generic value, although they always may help us in characterizing species.

A second character, to which M. Matheron has drawn attention, is the abbreviation of the spire. This appears to me of far less importance. I have had a good deal of experience in collecting large suites of *Nerinea* and *Actæonella*, and my impression is, that both these genera were principally inhabitants of shallow beaches between high and low water-mark, and that they often lived on stony ground or on coral reefs as the recent *Obeliscus* usually do. It is not often the case that a shell, which is to a great extent almost involute in the first stage of growth, becomes afterwards merely turreted, and this apparently turreted form is only produced by an erosion of the posterior margins of each whorl. Much more frequently it happens that the spire of the large shell is more or less eroded on the stony ground on which it lived, or before it had been finally imbedded in the rock. In some specimens this occurs probably during the young state of age, in others later, and again in some, which live in favorable and sheltered places, perhaps never, or to a much smaller degree. I do not know whether I am quite correct in these statements, but they have been derived from actual and practical observations. I may refer here to a few figures of *Itieria abbreviata* in the 'Jahrbuch Geol. Reichs-Anstalt', Wien, Vol. XIII, page 48, which species and the few described by Pictet are the only cretaceous forms apparently belonging to *Itieria* proper.

All these observations induce us to extend Matheron's name to forms with a conical or even turreted spire. It is due to Pictet and Campiche, that they have again introduced the name *Itieria* into the literature of fossil Mollusca, for D'Orbigny seems to ignore the genus altogether when speaking of his *Ner. Cabanetiana*, although it was certainly not unknown to him when he claimed the priority of his *Actæon*. The authors of the *Materiaux pour la Paléontologie Suisse*, 3me. ser., add to Matheron's species two other somewhat different forms, which we would be rather inclined to separate under the following designation of

9.—*Itruvia*, Stoliczka, 1867.

Testa ovata, seu conica, spira plus minusve elevata aut abbreviata; ultimo anfractu maximo, inflato; apertura lateraliter multo angustata, antice canaliculata, postice acuminata; columella solida, tortuosa, uni- seu bi-plicata; (labro intus edentulo; superficie testæ lævigata).

We deduce these somewhat incomplete characteristics from the five species which are at present known, namely,—

1. *Itruvia* (*Pyramidella*) *canaliculata*, D'Orb., Pal. Franç. terr. crét. II, p. 104, Pl. 164, Figs. 3—6.
2. „ (*Pyramidella*) *carinata*, Reuss, Böhm. Kreidef. II, 1847, p. 110, Pl. XLIV, Figs. 6 and 7). (*Pyr.*) *subcarinata*, D'Orb., Prod. vol. II, p. 191.
3. „ (*Itieria*) *truncata*, Pict. et Camp. Mat. p. 1, Pal. Suiss. 3me. ser., p. 218. Pl. LXIII, Figs. 1—4.
4. „ (*Itieria*) *umbonata*, Pict. et Camp. ibid. p. 220, Pl. LXIII, Fig. 5.
5. „ *globoides*, Stol., a new species, described in the following pages, and figured Pl. XIV, Fig. 1.

We unite also under the name *Itruvia* forms, which differ considerably in the height of the spire; this being in the two first named species produced, and almost turreted, in *It. globoides* short, and in the two described by Pictet scarcely elevated at all. These are therefore exactly similar changes, to those we have already noticed in *Itieria*. The reason, however, that we have separated the above named forms from *Itieria* lies principally in the formation of the columella and that of the anterior canal. The columella is always solid, twisted, and causes the presence of a short produced and slightly recurved anterior canal on the aperture, while in *Itieria* the aperture is itself more produced, without forming a regular canal. Certainly this must be connected with some distinctions in the animals. The differences are, I am well aware, not absolutely sharp, just as they are not in scarcely any other genera, and transitions could or may be in time traced; but the distinctions are in any case quite as truly serviceable as those proposed between *Pyramidella* and *Obeliscus*, perhaps even still greater.

In *Itruvia truncata*, Pict. and Camp., two columellar plaits are known; all the other four species have only one plait, and in all cases they are placed anteriorly and are thus strictly columellar. No folds have been as yet observed on the outer lip in any of the five species, which all present a smooth surface on the exterior of the shell. The ventricose form of the last volution and the presence of a distinct canal are equally important distinctions between *Itruvia* and *Syrnola*.

10. *Nerinea*, DeFrance, 1825.

Testa turrita, perlonga, anfractibus numerosissimis, plus minusve applanatis composita; ultimo ad peripheriam basalem angulato, antice abrupte terminanti; apertura angulari, antice sub-canaliculata; columella plerumque solida; (—? interdum excavata) labio sæpe tri-, labro intus bi-plicato, ejusque peristomate S-formi sinuato; in anfractibus omnibus fascia distincta, lineis minutissimis insinuatissimis ornata, postice infra suturam posita est.

With these characteristics we would restrict the name *Nerinea* to the much elongated and turreted shells, which have the last volution built in a perfectly symmetrical way to all the other whorls, so as not to exceed them considerably in size and form. It is angulated at the basal periphery, and terminates abruptly in a short, anterior canal. Each whorl has below the suture a narrow band, formed of solid shell-mass, on which, however, in cases of good preservation, fine insinuated lines of growth are traceable. This band, of which we shall always speak as the "sutural band," recalls, according to D'Orbigny, the somewhat similar form in *Pleurotomaria*. I have never had an opportunity of observing any *Nerinea* with perfectly preserved aperture, and cannot therefore say whether there is a posterior emargination present or not; if it is, as no doubt would appear very probable, it can be only small, for I did not observe it in nearly perfect specimens of *Ner. Buchi* and *nobilis*. I have also not been able to get very distinct sections of the shell, but it seems to me that the shell-mass which constitutes this sutural band is rather more in connection with the thickening of the inner than with that of the outer lip. Below the suture the striæ of growth are always curved in an S-form, depending upon a similar curve of the margin of the outer lip.

There are usually three or four folds present on the inner and two on the outer lip. Of the former, two are, strictly speaking, placed on the columella, the anterior stronger than the posterior, and two in a similar position on the inner lip, which forms the top of the angular aperture. I have consequently called them in my former notes on *Nerinea* the top-folds (*vide* Sitzungsber. Akad. Wien, 1865, LII, Revision etc. p. 25); they might perhaps be better called posterior folds. But it is scarcely necessary to make always these subordinate verbal distinctions, unless a special importance is attached to them. If figures of specimens be not given, lengthened descriptions and explanations cannot be avoided. Of the two columellar plaits the posterior is, although nearly always smaller, generally present, but it disappears often sooner towards the aperture, than the other plaits. Still in process of growth all the plaits in the interior of the whorls become usually thicker and often fill up the space perfectly. In consequence of this the uppermost whorls become often easily corroded, having been placed out of connection with the organism of the animal.

The columella is usually solid or only fissured on the last whorl; seldom it is hollowed out in its entire length as in the jurassic *Nerinea grandis* and *dilatata*, D'Orb., but it is always distinctly twisted.

10 a. By far the larger number of the *Nerineæ* with a hollow columella are cretaceous; they are mostly smooth shells, with angular whorls contracted in the middle, and three plaits in the aperture, one columellar, one posterior plait, and one on the outer lip. It is possible that in these forms another small group of *Nerineæ* may be distinguished, but I am quite unable to come to any certain conclusion, as I have nothing but mere figures to compare, and these refer often to casts of shells only. The doubtful *Pyramidella sagittata*, Sharpe, (Quar. Jour. Geol. Soc. VI, 1850, p. 193, Pl. XX, Fig. 8) belongs evidently to this group.

10 *b*. One of the oldest forms of *Nerineæ* is the *N. prisca*, Hörnes (Denksch. Akad. Wien 1856, XII, part II, p. 27, Pl. I, Fig. 4) from the Alpine Trias of Lower-Styria. It must, however, be remarked that the columella and the disposition of the folds differs remarkably from the typical *Nerineæ*, as above characterized. It has also no plait on the outer lip, and if the columella was straight, there may have been on the aperture itself only some emargination (if any) like a notch, notch similar to what is to be found in *Bullia* and other *BUCCINIDÆ*. In such a case I rather believe it more correct that the species ought to be generically separated.

I do not know whether any of the six species of *Nerineæ*, described by Stoppani from the upper Trias (vide Pal. Lomb. ser. I, Pétrifications d'Esino, 1858-60, p. 35-37) belong at all to this group of shells. None of them has columellar folds like other *Nerineæ*, and some of the species look much more like *Chemnitzia*, *Holopella*, etc. There are scarcely any species of *Nerineæ* known from the Lias, but typical forms occur already in the lowest beds of the Dogger; they are most abundant in the Malm or Upper Jura, and decrease gradually in the cretaceous period. Pictet and Campiche (Mat. p. l. Pal. Suisse, ser. III) enumerate nearly 80 species of *Nerineæ* from the cretaceous beds. The North of Europe and America are remarkably poorly represented, and by far the largest number is known from the Alps and the Mediterranean circle. It would appear, that they were all chiefly inhabitants of southern regions, equally as the living *PYRAMIDELLIDÆ* are. We shall notice three species, all belonging to the Ootatoor group of the Trichinopoly cretaceous deposits. *Ner. incavata*, Bronn, is identical with the European species; *Ner. Blanfordiana* is new, and a third species remains uncertain for the present as to its characters.

Of tertiary species two have, I think, been noticed, the *Ner. supracretacea*, Bellardi, (Mem. Soc. Géol. France, ser. II, vol. IV, p. 209, Pl. XII, Fig. 6) from the nummulitic beds near Nice, and the *Ner. serapidis*, Bellardi (Bull. Soc. Géol. France, ser. II, vol. VIII, p. 261) from nummulitic beds of Egypt. Of the latter I have not been able to procure more than the mere name, but the first has, judging from the figured section, all the appearance of a true *Nerinea*. It is evident that the specimens had all the shell surface worn off, and that consequently the plication on the outer lip is not marked. It would not be very surprising if the specimen had got into the nummulitic beds from some adjacent cretaceous strata.

11. *Cryptoplocus*. Pictet, et Campiche (Mater. p. l. Pal, Suisse, 3me. ser. p. 257).

Cryp. testa conica seu pyramidalis, anfractibus numerosis composita, late umbilicata; apertura quadrangulati, antice sub-effusa, postice uniplicata; labro edentulo.

The larger number of species belonging to this genus are smooth, except the *Cryptoplocus moniliferus*, D'Orb., sp., which as regards ornamentation certainly very closely resembles the *Nerineæ*. None of the species are known to have a sutural band, but so far as the shell has been observed in good preservation, it exhibits similarly curved striæ of growth, as invariably occur in *Nerineæ*. The aperture is

angular, and so far as can be seen from the direction of the striæ very slightly produced in front. There is a true umbilicus present, and the inner lip is reduced to a small posterior portion attached to the previous volution and provided with a single fold. Such great differences as these in the formation of the shell certainly necessitate the proposition of a new genus, as has been done by Pictet and Campiche; the authors equally express their opinion as to the relation of this genus with *Nerinea*.

The present known species of *Cryptoplocus* are the following :—

Jurassic.

C. depressus, Voltz. (Bronns' Jahrb. 1836, p. 549, Pl. VI, Fig. 17), Peters, in his able paper on the *Nerinea* of the upper Jura (Sitzungsb. Akad. Wien, 1855, vol. XVI, p. 362), draws attention to the discrepancy between Bronns' figure and description, and that of D'Orbigny, described under the same name and figure (Pl. 259) as *Ner. umbilicata* (? Voltz.) D'Orbigny. If we had to judge from mere figures, certainly the convexity of the whorls in the latter and the difference in form and position of the fold would indicate another species, which could remain,

1 *a*, under the name *Cryp. umbilicatus*, although it would not be very characteristic. I do not think, however, that Bronn's figure is quite so safe as to guarantee this alteration. All these shells, as I have already noticed, erode very much even during life-time, and convex as well as concave whorls of *Nerinea* appear often as quite flat.

1 *b*. Zieten figures (Petr. Wurtbg. 1830, p. 48, Pl. XXXVI, Fig. 3) a species from the coral-rag of Nattheim as *Nerinea terebra*. It is evidently a true *Cryptoplocus* allied in form, but much thinner than any known specimens of *C. depressus*; the whorls are slightly concave, and the sutural angle about 16 degrees.

1 *c*. Goldfuss (Petr. Germ. III, p. 40, Pl. 175, Fig. 7) figures another very similar form, as *N. subpyramidalis*, Münst, which agrees very much with the original *N. depressa* of Voltz. The *Nerinea depressa*, Voltz of Zeuschner (in Haidinger's Abhandlg. 1850, III, p. 137, Pl. XVI) could probably be added to this series, but it differs markedly from the others by its sutural swellings.

Quenstedt (Jura p. 765) is of opinion that most of these forms are identical, and he may be correct in this. For comparison only I had taken the proportions of the height to the diametral width of one whorl in the different forms, which had been figured, and they arrange themselves thus—

<i>Ner. terebra</i> in Zieten	...	...	height	:	width (consd. as 1.00)	= 0.47
„ <i>depressa</i> of Bronn	...	...	„	„	„	= 0.39
„ „ of Zeuschner, Fig. 2	...	...	„	„	„	= 0.38
„ „ „ Fig. 1	...	...	„	„	„	= 0.35
„ <i>umbilicata</i> , in D'Orbigny	...	...	„	„	„	= 0.35
„ <i>subpyramidalis</i> in Goldfuss	...	...	„	„	„	= 0.34

With respect to these measurements we could justly separate at least two forms, the *Cryp. terebra*, Schübl. sp. and the other four under the name of *Cryp. depressa*, Voltz. sp., but as otherwise no well preserved specimens of all these forms, which have been referred to, are as yet known, or have not at least been examined, it would perhaps not be advisable to fix these specific alterations at present.

2. *Cryptoplocus pyramidalis*, Münst. sp. (*Nerinea* id. in Goldf. Petr. Germ. III, p. 43, Pl. 176, Fig. 11; and Peters, in Sitz. Akad. Wien, 1855, XVI, p. 361, Pl. IV, Figs. 1—3). Dr. Peters, identifies with this species Zeuschner's *N. depressa*, but the proportions of whorls in the latter species, and of course of the animals respectively, agree rather with the *Ner. depressa*.

These proportions are as follows:—

<i>Cryp. pyramidalis</i> , Ner. in Goldfuss.	height	:	diametral width of a whorl (consd. as 1·00)	= 0·28
„ „ „ „ Peter's Fig. 1	„	„	„	= 0·28
„ „ „ „ „ Fig. 3	„	„	„	= 0·29

This shows clearly the difference between the measurements of Zeuschner's figures, quoted above. The present species had been first referred by Münster to the cretaceous deposits of the Gosau; its true jurassic position was, however, afterwards recognised through Dr. Peter's researches.

3. *Cryptoplocus conicus*, Stoliczka, 1867 (*Nerinea subpyramidalis*, in D'Orbigny's Pal. franç. terr. jur. II, Pl. 279). There can be no question as to the distinction of this species from Münster's *C. subpyramidalis* and Peters very properly remarks, that he is astonished how D'Orbigny could identify both. Quenstedt also says that he never met among specimens of *N. depressa* and *subpyramidalis* any such form as had been figured by D'Orbigny.

Height : diametral width (consd. as 1·00) of one whorl according to D'Orbigny's figure... 0·19

Cretaceous ;

4. *Crypt. brevis*, D'Orb. sp. Pal. franç. terr. cré. II. p. 92, Pl. 162, Figs. 3 and 4.
5. „ *monilifer*, D'Orb. sp., ibid. p. 95, Pl. 163, Figs. 4—6.
6. „ *Sancta-Crucis*, Piet. et Camp. Mat. p. 1. Pal. Suisse, 3me. ser., p. 260, Pl. 69, Fig. 6.
7. „ *annulatus*, Sharpe, sp. Quar. Jour. Geol. Soc. Lond. 1850, VI, p. 112, Pl. XIII, Fig. 1.

The whorls of this last named species are somewhat concave; Sharpe says, however, distinctly “one fold in the interior, on the top of the whorl, curving outwards.”

We cannot conclude these notes on *Cryptoplocus* without referring to a few very similar forms.

Piette described in the XII. volume of the Bull. Soc. Géol. de France, 2d. ser. p. 1114, Pl. XXXI, Figs. 5-8, a *Nerinea patella*, which agrees in the form of the shell perfectly with *Cryptoplocus*, but has one fold (tooth?) on the outer lip.

D'Orbigny (Pal. franç. terr. jur. II, Pl. 305, Figs. 6-9) figured a *Trochus monoplacus*, which is transferred by Eug. Deslongchamps to *Niso* (vide Bull. Soc. Linn. Norm. V, p. 125, Pl. XI, Fig. 3). Certainly the species is not a *Trochus*, but I do not think it can be left in the same genus with typical species of *Niso*, for it has one distinct and strong fold on the columellar portion of the inner lip. We could quote several other examples, but it will suffice here to show that there are fossil forms of shells, which agree in every respect with *Cryptoplocus*, but some of which have one fold on the outer lip and some on the columella. Ought these forms to be separated as distinct genera, or ought the characteristics of *Cryptoplocus* to be extended to include them by allowing a change in the place of the fold? This is a point which cannot be properly decided without a close comparison of respective well preserved shells, and without knowing the physiological and morphological importance of that fold in at least one closely allied genus. We need scarcely remark that *Cryptoplocus* has its nearest ally, as to the form of the shell, in *Niso*, and if some species (as, for instance, *C. monilifer*) did not exhibit a structure of the shell so remarkably similar to that of *Nerinea* and others, we could place it among the *EULIMIDÆ*; or perhaps more correctly place *Niso* and the allied genera here, instead of in the last named family. This only shows the close relationship

of the *EULIMIDÆ* with the *PYRAMIDELLIDÆ*, and our separation may be justly considered a forcible one. There is some drawback to every attempt at classification; nothing will fit properly in the frame we try to make for nature!

Several propositions have been previously made as to the division of the *Nerineæ* into several genera, but we are certain that none based upon a *single* character, like that of Sharpe on the number of folds, can be successful. We do not pretend that we have obtained success with our present proposition, but we trust it will be found a step further on towards the solution of the problem. We believe that only a division, which is based upon the total form of the shell, but which must at the same time pay strict attention to all the other characters, as, for instance, the number and position of folds, length of the anterior canal, ornamentation, etc., can finally succeed.

XLIII. ODOSTOMIA, *Fleming*, 1848.

(Vide p. 173.)

1.—ODOSTOMIA ANTIQUA, *Stoliczka*, Pl. XXI, Fig. 6.

Odost. testa conica, solidula, spira acuminata; anfractibus 5—6, lævigatis atque politis, convexiusculis, regulariter crescentibus; ultimo subinflato, ad peripheriam rotundato; basi in adultis speciminibus spiraliter sulcata; apertura ovata, plicæ columellari sub-antica, oblique torta.

Spiral angle 45° — 50° ; sutural angle 6° — 8° .

The slightly convex and regularly increasing volutions appear to be specially characteristic for this cretaceous form. Young specimens are perfectly smooth; more fully grown have the basis of the last whorl spirally sulcated. The number of whorls of the species is somewhat larger than in many other *Odostomiæ* and may be said to form a transition to *Syrnola*, which is, however, still more elongated and more like *Obeliscus*.

Locality.—Garudamungalum, in a blueish calcareous sandstone; rare.

Formation.—Trichinopoly group.

XLIV. ITRUVIA, *Stoliczka*, 1867.

(Vide page 177.)

1.—ITRUVIA GLOBOIDES, *Stoliczka*, Pl. XIV, Fig. 1.

It. testa ovato conica, lævigata, spira brevi; anfractibus gradatis; ultimo maximo, subcylindrico; apertura ovali, postice angustata; columella antice uniplicata.

Spiral angle 78° — 82° .

A smooth, ovate shell, with a short spire composed of numerous volutions, which terminate abruptly at the suture. The last whorl is subcylindrical, with slightly convex outer periphery, more than twice as high as the spire, and anteriorly abruptly contracted. The aperture is ovate, posteriorly narrower, and anteriorly with one columellar fold.

When the callosity of the inner lip has been removed, there appear on such imperfect specimens some spiral striæ or plaits, which have also been noticed by Prof. Pictet in *It. truncata* (loc. cit., Fig. 4b). Another point worthy of notice is, that the inner space of the whorls becomes posteriorly narrower or perfectly filled up with shell-mass during the process of growth of the animal, and the consequent increase of whorls. This is the reason that the section of the aperture is so much smaller in imperfect specimens, than is the real aperture in perfect shells. Exactly the same thing can be very often observed in *Actæonella* (vide same Plate, Fig. 10).

Locality.—Comparapolliam in the Trichinopoly District; a rare shell.

Formation.—Arriallor group.

XLV. NERINEA, DeFrance, 1825.

(Vide p. 177.)

1. NERINEA INCAVATA, Bronn, Pl. XIV, Fig. 2.

1836. *Nerinea incavata*, Bronn, Tahrh., p. 553, Pl. VI, Fig. 22.

1843. *N. incavata et cincta*, Munst. Golf. Petref. Germ. III, p. 45, Pl. 177, Fig. 1; and Pl. 176, Fig. 12.

1852. *N. eadem*, Zekeli, Abhandlungen der Geol. Reichs-Anst. Wien, vol. I, pt. II, p. 36.

1853. *N. eadem*, Reuss, Sitzungsab. Akad. Wien, vol. XI, p. 891.

1865. *N. incavata*, Bronn; Stoliczka, ibid, vol. LII; Revision der Gosau-Gast., p. 31.

N. testa subcylindrica, perlonga; anfractibus rectangularibus, ad medium excavatis, in junioribus ad suturam anteriorem crenulatis, in adultioribus nonnunquam paulo tumescentibus, lævigatis; fascia suturali angusta; apertura angulata, sex plicis inæqualibus instructa; duabus in columella solida positis, duabus in labio posteriori atque duabus in labro; plica anteriori semper multo fortiore quam posteriori; canali brevi, recurvo.

Height of one whorl : its width (considered as 1·00) ... 0·39 — 0·40.

The shell begins its growth with an angle of from 15—20 degrees. After some time, when the number of whorls increased to about 10—15, the angle decreases to 10 degrees, and still farther on the shell becomes almost cylindrical. The total number of whorls is in larger specimens 50—60. All of them are concave about the middle, and when young, the anterior margin along the suture is often crenulated; older specimens have the whorls quite smooth, only with S-form curved striæ of growth, perceptible below the narrow sutural band.

The aperture is rectangular with six folds, two respectively on the solid columella, the posterior portion of the inner lip and the outer lip; the anterior or lower fold is in each case much stronger than the posterior or upper. In cases where the aperture is preserved, all the folds, except the anterior columellar, are seen to have become obsolete.

This species was first described by Bronn, from Transylvanian specimens, of which some years ago Mr. Stur, of the Austrian Geol. Institute, collected a very fine series. On account of these materials, I have pronounced Münster's *N. cincta*

as identical with the previous species (vide Jahrb. Geol. Reichs-Anst. 1863, vol. XIII, p. 50). Münster described his *N. cincta* from the Gosau, but I never met with it, nor have I seen anywhere a specimen which had been collected in these Alpine cretaceous deposits, although there is no reason to assign, why it ought not to occur, for several of the fossils from Transylvania and the Alps are identical. The species has been lately found in the cretaceous deposits of Löwenburg in Germany. Our South Indian specimens agree perfectly with those from Transylvania, which I had compared.

In my paper, quoted above, I have also drawn attention to the similarity of *N. Conimbrica*, which had been described by Sharpe from Portugal. What Schafhäutl (Leth. Geog. Süd-Bayerns 1863, p. 389), Pl. LXV d, Fig. 2) describes and figures as *N. cincta*, Münt., along with most of the other determinations of this author, must first be a little better ascertained before it be admitted.

Locality.—From a conglomeratic coarse sandstone of the neighbourhood of Parully in the Trichinopoly District; rare.

Formation.—Ootatoor group.

2. NERINEA BLANFORDIANA, *Stoliczka*, Pl. XIV, Figs. 4-6.

Ner. testa turrila; anfractibus medio excavatis laevigatisque, margine anteriori semper tumescente atque tuberculato, posteriori ad fasciam suturalem interdum levigato, interdum sub-tuberculato; columella, labio atque labro biplicatis, plicis anterioribus semper crassioribus; plica posteriori in labio saepe obsoleta.

Spiral angle 20° — 25° ; sutural angle 3° — 5° .

Height of one whorl : its width (considered as 1.00) ... 0.30—0.36

The difference in the proportions of the whorl and the greater spiral angle distinguish this species easily from the *N. incavata*, even when the preservation of the specimens is not very good. The sutural band is always very narrow, sometimes scarcely traceable. The posterior margin of each whorl is either smooth (vide Fig. 4, a very much worn specimen from a coral limestone), or, where the surface of the shell is better preserved, ornamented with large tubercles; the middle portion is concave and smooth (vide Fig. 5); the lower margin always somewhat enlarged and tuberculated. The columella is solid, and has like the posterior portions of the inner and of the outer lip each two folds, the upper or posterior ones being in each case much thinner and becoming often obsolete near the aperture.

This species resembles, as regards form and the changes in ornamentation, very much the *Nerinea Buchii*, Kfst. sp. from the Alpine Gosau formation (vide Abhand. Geol. Reichs-Anst. Wien, 1852, Vol. I. pt. II, p. 31, and Sitzungsber. Akad. Wien, 1865, Vol. LII, Revision, etc., p. 27). The European species differs by its usually hollow columella, even or much less concave whorls, and in having above the anterior tuberculated margin of each whorl a deeply impressed line, interrupted by the prolongation of each tubercle. This latter character is additional for *N. Buchii*, and has not been, I believe, previously noticed.

Localities.—W. N. W. of Moraviatoor; common in coral limestone (vide H. Blanford's Report in Mem. Geol. Surv. India, Vol. IV, pt. I, p. 90), but rare in the conglomeratic sandstone near Parully in the Trichinopoly District.

Formation.—Ootatoor group.

3. NERINEA, *sp.* Pl. XIV, Fig. 7.

Two cast specimens have been found of this species, one in the calcareous sandstones near Moraviatoor, and one in the limestones near Odium. It is remarkably conical and short, not so cylindrical as other *Nerineæ*. The section of the whorls exhibits two columellar folds, and two on the outer lip, of which, however, rather exceptionally, each posterior one is almost stronger than the lower. The posterior portion of the inner lip has only one strong fold. Towards the aperture there are on the anterior portion of the outer lip some distant impressions of three-toothed varices noticeable. By these varices the inner spaces of the aperture must have been made still narrower than would have resulted from the thickening of the other folds. No trace of the surface of the shell has been as yet found preserved. I am not acquainted with any exactly similar species, and my present object in figuring the incomplete specimen is only to draw attention to this interesting form.

Formation.—Ootatoor group.

XIX. Family—CERITHIOPSIDÆ.

(*Vide* Adams' Genera I, p. 239; Gray's Guide, 1857, p. 56.)

When we compare the animals of this family with those of the *PYRAMIDELLIDÆ* and the shells with those of the *CERITHIIDÆ* there could be no better place assigned to it. Gray acknowledges the first relationship, but H. and A. Adams place the family altogether out of connection with any of these two. L. Reeve—*Conch. Icon*—says that, the shells of *Cerithiopsis* are not to be distinguished from those of *Cerithium*, and he does not consequently accept the first genus at all. This we certainly believe to be a little exaggeration. There are many particulars in the structure of the shell of *Cerithiopsis* to be noticed which appear to be characteristic for it, although much dependence is scarcely to be placed upon the form of the shell in general. Where, however, such marked distinctions have been verified, as those which are known to exist between the animals of *Cerithiopsis** and *Cerithium*, and where the respective shells are well known, it is certainly, at least with respect to these known species, not correct to disregard these distinctions, instead of being a little more patient and awaiting a more certain solution of those cases, which are as yet doubtful. The family may, therefore, be retained, but it ought to stand close to the *CERITHIIDÆ*.

It will be easily understood if there are already such great difficulties experienced in the determination of the recent shells, that the determination of fossil species must be much more doubtful. That forms of *Cerithiopsis*, resembling extremely

* And the sub-generic forms *Alaba*, *Diala*, *Seila* (Ann. Mag. Nat. Hist. 1861, p. 131) and probably some others.

those of the recent *Cerithia*, did exist in former times, even as far back as the jurassic period, can scarcely be questioned; but we require good materials before we can attempt to point out such slight differences, and even in such cases the fossil shells must always be carefully compared with those of the living species as regards their structure. Only in this way can we arrive at something like a correct determination of these forms.

From the cretaceous deposits merely a few North American species have been referred to *Cerithiopsis*, like *C. Moreauensis*, Meek and Hayden (Proc. Acad. Nat. Sc. Phil. 1860, p. 185), and *C. alternata*, Gabb (Pal. Calif. 1864, I, p. 116), but neither of these species is known in such a sufficient state of preservation as to warrant these determinations. Exteriorly they agree with other well known *Cerithiopsis*. We have ourselves put aside a fragment of an apparent *Cerithiopsis* from the Arrialoor sandstones near Comarapolliam. It is a small sub-cylindrical species with convex whorls, spirally striated, and transversally obsoletely costulated.

XX. Family—*CERITHIIDÆ*.

(H. and A. Adams' Gen. I, p. 283; *CERITHIADÆ* Gray's Guide, 1857, p. 105.)

The animals are characterized by a broadly produced annulated rostrum; usually long, subulate, tentacles with the eyes on bulgings or short pedicles at their outer base, and by a linear lingual membrane with seven series of teeth, the central being single, hooked, and denticulated, the lateral decreasing in size towards the outer margins, and all of them multicuspid. The mantle margin has a distinct siphonal fold or a slit in front; the gills are composed of a single series of cylindrical rigid plates. The foot is short, broad, and usually well adapted for sliding. Operculum always present, horny.

The shell is turreted, generally with an elongated spire, and in the recent species covered usually with a thin, or in the fluviatile or brackish species with rather a rough epidermis; the aperture is generally channelled in front, or at least distinctly effuse: the outer lip often expanded, and externally varicose in adult specimens.

For many years past palæontologists have drawn attention to the close relationship which exists between the shells of the *CERITHIIDÆ* and those of *PYRAMIDELLIDÆ*, specially of *Nerinea*. Since the establishment of the *CERITHIOPSIDÆ* these relations obtained a still firmer basis in consequence of the great similarity of the animals of *Cerithiopsis* with those of *Pyramidella*, and, even as regards the usually prolonged form of the shell the former genus appears to be closely connected with the latter.

We have already, when speaking of the last two families, repeatedly referred to these relationships, and thus given expression to our views regarding the classification of the *CERITHIIDÆ*. The invariable existence of a distinct siphonal fold and even that of a short siphon, corresponding usually with a produced anterior canal on the aperture, entitles this family fully to the place which we assign it at the

end of the SIPHONOSTOMATA, so long as this tribe of Mollusca is retained with any regard to systematic value. We cannot perceive for what reason such distinctly canaliculated shells ought to be summarily transferred to the HOLOSTOMATA, and it seems to us that this error has been habitually introduced by a mistaken identification of the former tribe with the signification of ZOOPHAGA, and that of the latter with the PHYTOPHAGA. If this latter classification be adopted, there must be several and very considerable changes effected in the arrangement as proposed at the present. There is not, however, very much importance to be attached to either of these divisions.

H. and A. Adams proposed two sub-families, *CERITHIINÆ* and *POTAMIDINÆ*, the latter of which would form a transition to the *MELANIIDÆ*. It is usually stated, that this proposition was made on account of the paucispiral and oval, or multispiral and circular form of the operculum alone, but the mode of living of the species in both these divisions and the differences of the structure dependent upon it are far more important, the first being marine, the latter brackish or fluviatile inhabitants. The shells of the *POTAMIDINÆ* exhibit consequently many minor differences in their structure, they have generally a shorter and less deeply channelled anterior termination, a thick epidermis, etc. We fully concur with many conchologists in the desirability of keeping up this distinction into two or perhaps, according to Gray, into three families, adding the *TRIPHORINÆ*. Instead of obliterating those results, which have been obtained after much tedious work, it would be more appropriate to seek first for new facts, and to see whether these divisions could be made more practicable for the palæontologist. The same might be said with regard to the genera and sub-genera, which have been established by different authors. We restrict our remarks chiefly to the marine forms only. It is true that, so long as we are not in the possession of well preserved fossil materials, palæontologists will adhere for many years to a general name, such as *Cerithium*, but that mere name cannot continue to comprise all the great variety of forms.

a. Sub-family—*CERITHIINÆ* (*Cerithium*, auctorum).

There is not much known of palæozoic forms of the *CERITHIINÆ*, but the oldest secondary species exhibit a remarkably close relationship to *Nerinea* of the *PYRAMIDELLIDÆ*. For a number of these old *Cerithia* Piette proposed the name

1. *Fibula*, 1857 (Bull. Soc. Géol. France, Vol. XIV, p. 556). The shells are turreted, of moderate thickness, smooth or with short semi-obsolete transverse ribbings, a short canal, and contorted columella. The triassic species described and figured by Stoppani as doubtful *Nerinea* (see Pal. Lomb. 1 ser. Pl. VII and VIII) or the *Cerithium Esinense* of the same author (ibid, Pl. XV, Fig. 11), are among others the oldest representatives of this genus. Piette notes several jurassic species from the 'Bathonien' of the Ardennes department, and others are known from the German and English Jura. In the more recent deposits these forms are much more rarely to be met with, although we know little as yet about the true character of cretaceous species, like *Cer. excavatum* (Pict. et Roux; Grès verts, Pl. XXVII, Fig. 7)

or still less of the Gosau *Rostellaria depressa*, Zek. (Abhand. Geol. Reichs-Anst. 1852, Vol. I, Pt. II, Pl. XIII, Fig. 2). Our *Cerith. detectum*, n. sp. may be another cretaceous form, belonging to this group. The *Cerith. Cassendii* and *Nostradami*, Coquand (Etage Aptien de l' Espagne, 1866, Pl. IV, Figs. 14, 15, 16), are probably true *Fibulæ*.

1. *a.*—With these chiefly smooth species there are others connected, which agree with them in form, but have usually a row of strong tubercles along the posterior suture; the tubercles being produced by a kind of insinuation in this place on the outer lip. We refer here to the jurassic *Cerith. margaritifera*, Piette, (? d'Arch.; Bull. Soc. Géol. France. 2me. ser. XIV, p. 555, Pl. VI, Figs. 1—3), or the cretaceous *Cerith. hispidum*, Zek. (Abhand. Geol. Reichs-Anst. 1852, Vol. I, Pt. II, Pl. XXIV, Figs. 1, 2, 6, 7), which I referred to *Vertagus* (Sitz. Akad. Wien, 1865, LII, Rev. etc. p. 110), because it has a columellar fold, although it must be conceded, that the form does not agree very much with recent species of *Vertagus*. We describe two other very similar forms from South India, namely, *Cerith. hispidulum* and *inauguratum*, n. sp.

The cocene *Cerith. giganteum* belongs to this same group of species.

1. *b.*—A third series of very remarkable forms of *Cerithium* are principally cretaceous; they are distinguished by a remarkably striking resemblance to *Nerinea*, great thickness of the shell, and transversally coarsely ribbed or tuberculated whorls. I mean under this section species like *Cerith. Haidingeri*, Zekeli (l. c. Pl. XXIV, Figs. 3, 4, 5, 8, 9), from the Alpine Gosau-deposits, or *Cerith. Sturi*, Stoliczka (Jahrb. Geol. Reichs-Anst. 1863, Vol. XIII, p. 50, Fig. 4), and others.

The sole representative of all these fossil forms among recent shells appears to be *Cerith. læve*, Quoy and Gaim. (Voy. Astrolabe, Vol. III, p. 106, Atlas Pl. 54, Figs. 1—3). It is astonishing to find this species placed by the late L. Reeve (Conch. Icon. 1866) in *Telescopium*. The author had evidently not referred to the original figure of the species in the Atlas of the 'Astrolabe', otherwise he would have found in Fig. 3 a representation of a paucispiral operculum, such as he had occasion to observe on Mr. Hanley's specimen. Quoy and Gaimard state, that they found the species at the entrance into King-George's Sound, South Australia.

2. *Eustoma*, Piette, 1855 (Bull. Soc. Geol. France, 2me. ser. XII. Vol., p. 1107, and XIII Vol., p. 99, Pl. II, Figs. 8—11), has been proposed for a jurassic turreted species with an ornamentation like the doubtful *Fibulæ* mentioned in 1*a* (vide *Cerith. hispidulum* n. sp.), but both the margins of the aperture are much expanded and posteriorly united by an indistinct canal. The considerable expansion of the inner lip distinguishes this form from *Rostellaria*, and the ornamentation of the shells agrees undoubtedly better with the *CERITHIIDÆ*, on which account we would prefer to classify this genus here. Besides the *Eust. tuberculosa*, Piette, another jurassic species, the *Cerith. rostellaria*, Buvignier (Stat. d. l. Meuse, Pl. XXVII, Figs. 7—9), and probably the triassic *Cerith. Donati*, Stoppani (Pal. Lomb. 3me. ser. Pl. XXVIII, Figs. 14 and 15), belong to this genus. We are not aware that any cretaceous species of *Eustoma* have been reported.

3. *Ceritella*, Morris and Lycett, 1850 (Moll. Great Oolite, Pt. I, p. 37.)= *Tubifer*, Piette, 1856 (Bull. Soc. Géol. France, 2d ser. XIII. Vol., p. 203), also proposed for a number of small jurassic shells which resemble *Actæonina* in form, the last volution being somewhat ventricose and largest, but terminating anteriorly with a short and slightly twisted canal. The whorls are either smooth or often ornamented with short transverse ribs, seldom spirally striated as usually in the *Actæonidae*. The name *Tubifer* must yield to that of *Ceritella*, the latter having priority. No cretaceous species of *Ceritella* are as yet known, although the genus appears very, numerously represented in the middle jurassic beds.

4. *Brachytrema*, Morris and Lycett, 1850 (Moll. Great Oolite, Pt. I, p. 24), including turbate shells with usually convex whorls, ornamented by spiral striæ and transverse nodulose ribs, thus approaching already more to the typical forms of *Cerithium*. The aperture terminates anteriorly with a short canal, the columella being somewhat twisted. Piette (Bull. Soc. Géol. France 2nd Ser. XIII. Vol., p. 597) referred some of the species belonging to this genus to *Purpurina*, (*Purp. costellata*, and oth.) which genus we would rather see classed either with the *TRICHOtropidæ*, or with the *LITTORINIDÆ*.

Of *Brachytrema* also no cretaceous species has been reported, but it is probable that some, like *Cerith. Phillipsi*, Leym. (Mem. Soc. Géol. France, V. page 14, Pl. XVII, Fig. 12) and a few others belong to this genus. They agree at least much better with the jurassic *Brachytrema*, than with other species of *Cerithium*, proper.

5. *Mesostoma*, Deshayes, 1864, Anim. s. Vert. Foss. du bas. de Paris, 2nd edit, II. tom., page 416) has, we believe, to be classed here, and not with the *Rissoïdæ* as proposed by Deshayes. It is even very doubtful whether those species, which have suggested the new generic name, are really different from *Brachytrema*; their form is almost exactly the same as in many species of the last genus and only the fact of the transverse ribs being somewhat more numerous and less nodulose could form a distinction, if this can be really regarded as such. The shell of *Mesostoma* appears to be thinner than that of *Brachytrema*, and the columella is stated to be hollow, but *Brachytrema* has also often a fissured columella.

6. *Exelissa*, Piette, 1861 (Bull. Soc. Geol. France 2nd ser. Vol. XVIII., p. 15): *Kilvertia*, Morris, 1863 (Suppl. Monog. Gast. Great Oolite, etc., p. 15 and 93). Both names have been proposed for the same species as type, the *Cerith. strangulatum*, d'Arch., and the genus includes a large number of very characteristic, transversally ribbed species. D'Archiac in his original figure of *C. strangulatum* (Mem. Soc. Géol. France. V, Pl. XXXI, Fig. 1) restores the species as having a short anterior canal, but Piette and Morris say, that there is no anterior canal present. We are sorry that we have no good specimens of the typical *Exelissæ* to compare, but the question as to the existence or non-existence of a canal does not appear to us quite settled. We have made a few observations on a cretaceous species, *Cerith. muricatum*, Forb., which agrees in the ornamentation very much with other jurassic *Exelissæ*, and we find that in very young specimens there is scarcely a trace of a canal perceptible. The margins appear united all round,

and the aperture is oval or nearly circular and somewhat dissolute from the last volution. In full grown specimens the anterior canal is distinct, but it is almost tubular, like in *Triphoris*, and communicates with the apertural space only by a very narrow hole. When the canal is accidentally broken away, it is very difficult indeed to resume its former existence, and the aperture then appears to have had continuous margins. Taking into consideration, that of all the species which have as yet been described as *Exelissæ*, not one has been recorded with a really perfect aperture, and that nearly all of them are known from small specimens only, it should not surprise us, when a short anterior, and, as I have stated, rather a tubular canal may be proved to exist. It is of course merely a conjecture for the present, for we cannot give any decisive opinion whatever on the subject. But if there were really no trace of an anterior canal present in *Exelissa*, the genus ought necessarily to be transferred to the *SCALARIIDÆ*, with which the posteriorly united margin of the aperture otherwise agrees.

There is a large variety of jurassic species of *CERITHIINÆ* known, which will most probably suggest several new generic names, as for instance the many-whorled species resembling *Turritella*, but with a distinct anterior canal; others with numerous angular whorls and somewhat of a more cylindrical shape, like some species of *Colina*, but with only a very shallow canal and expanded inner lip, similar to *Eustoma*, and others. We abstain here from any further remarks, for it is to be expected that all these forms will receive proper attention at the hands of M. Piette, who has undertaken the continuation of the jurassic Gastropoda in D'Orbigny's 'Paléontologie française.'

There is a large number of cretaceous species, which are distinguished by their conical form and flattened volutions, resembling *Elenchus* or *Bankivia* of the *TROCHIDÆ*. They have a short contorted canal and apparently a very thin outer lip. But as we are not in possession of any complete specimens, we are contented to direct attention to this group of *Cerithium*, although it is very likely that they must be generically distinguished from others. As typical forms we would quote *Cer. ornaticissimum*, D'Orb., *C. Mosense*, Buvignier, *C. Coqandi*, Pict. et Camp.; *Cer. fertile*, n. sp., and other similar forms.

7. *Sandbergeria*, Bosquet, 1860, has been proposed for a number of tertiary, ovate species, which have a very broad, shallow, but slightly prolonged canalication in front. If the paucispiral operculum, to which Mr. Bosquet refers, really belongs to species of this genus, it can be justly retained. Deshayes (Paris foss. 2d. edit., Vol. III, p. 112) is of opinion that, although belonging to a very marked section of *Cerithium*, the characters are not sufficient to justify a separate genus. If these shells belong to the *CERITHIINÆ*, that is, if the paucispiral operculum is a genuine one, they ought to be generically separated from *Cerithium*, but if it can be proved that the operculum was circular and multispiral, it would be very difficult to draw a line between *Sandbergeria* and *Cerithidea*, and perhaps *Mesalia* of the *TURRITELLIDÆ*. With regard to *Cerithidea* there is only one point which deserves attention. Looking upon the recent species of this genus it may be seen, that the

anterior canal itself is always somewhat deepened, the columella terminating abruptly on it, while in *Sandbergeria* there is no such separate canal, and the columella flattens out very gradually into the shallow depression of the margin. A reference to Reeve's Monograph of *Cerithidea* and to Deshayes' Atlas, Pl. LXXXI, Figs. 2, 6, 10, 18, a.oth., will make this clear enough. We have among the Indian fossils two species which probably belong to the section *Sandbergeria*; *Cer. antecessens*, n. sp. and *C. crispicans*, n. sp.

8. *Fastigiella*, Reeve, 1848 (H. and A. Adams, Gen. I. p. 155.), a turreted shell with spiral ridges, without transverse ribs, but umbilicated.

9. *Cerithium*, Adanson, 1757 (H. and A. Adams' Gen. I, p. 284).

10. *Vertagus*, Klein, 1753 (ibid, p. 285).

11. *Colina*, H and A. Adams, 1853 (ibid, p. 286).

b. *Sub-family*,—*TRIPHORINÆ*.

Vide *Triphorina*, Gray's Guide, 1857, p. 108.

Triphoris, Deshayes, 1830 (Adams' Gen. I, p. 287).—It is likely, that the sub-genus *Ino*, Hinds, would form a good generic distinction, and that a good number of the slender turreted jurassic species of *Cerithium* belong to it. They would appear somewhat like not perfectly developed species of *Triphoris*, which seems also to be the case with the recent shells.

b. *Sub-family*,—*POTAMIDINÆ*.

We have already referred to some of the more prominent distinctions of this sub-family, and they will be found treated more in detail in any of the newer Manuals. The genera are numerous, but pretty well known, and have been lately monographed by L. Reeve in his 'Conchologia Iconica.' It is remarkable to hear this conchologist often saying, that it is very difficult to specify distinctly the characters of one or the other genus, but, when the respective species are placed beside each other, they are so similarly formed that nobody would hesitate a moment to refer the same to one genus. It is evident, that there are still some characters to be discovered in these shells, and that we have not as yet succeeded in pointing them out distinctly.

The genera usually distinguished are: *Bittium*, *Pyrenella*, *Tympanotonus*, *Potamides*, *Pyræus*, *Telescopium*, *Cerithidea*, and *Lampania*.

Strictly speaking, the *POTAMIDINÆ* cannot be looked upon as anything else than *CERITHIINÆ*, which have been transformed and changed under somewhat different conditions, as the influence of the medium in which they lived, etc. They form in this respect a good transition to the *MELANIIDÆ*. It is nearly the same case, as we shall see more clearly and extensively developed in the *Rissoïdæ*. It must never be lost sight of, that the *POTAMIDINÆ* could develop themselves only where the necessary conditions were favorable for them. On precipitous sea-coasts, where

the pure marine water has free access, they are generally wanting, while at or near the mouths of great rivers, or in brackish swamps and lakes, they are most abundant. In the fossil state we have, therefore, to look for them only in deposits formed under similar conditions. They are not wanting either in the Vienna, or in the Paris and London basins, at Ronca in Venetia, and numerous other places in the tertiary epoch (*Cerith. Duboisi*, Hörn.; *Cer. margaritaceum*, Brocc.; *Cer. elegans*, Brug., and others).

Among the secondary deposits we find the *POTAMIDINÆ* equally represented in cretaceous beds, and they have been traced with certainty also in the Wealden deposits. As regards the cretaceous species, I can only refer to my 'Revision of the Gosau Gastropoda' (Sitz. Akad. Wien, 1865, Vol. LII, p. 91, etc.), where I have attempted to prove that the largest number of the *CERITHIIDÆ* from those deposits belong to the *POTAMIDINÆ*. I have, however, nothing to add to this sub-family from South India.

a. Sub-family—*CERITHIINÆ*.

XLVI. *CERITHIUM*, Adanson, 1757.

1. *CERITHIUM* (*FIBULA* ?) *DETECTUM*, *Stoliczka*. Pl. XV, Fig. 1.

Cer. testa acute turrita; anfractibus circiter septenis, altis, lævigatis, postice ad suturam paulo contractis, antice et ad medium subconvexis, varicibus nonnullis distantibus atque depresso interdum notatis; ultimo ad basim obtuse ac rotundate angulato; apertura ovata, postice acuta, antice canali brevi, contorto atque paulo lateraliter curvo terminata.

Spiral angle 24° ; sutural angle 15° .

Height of last whorl	: total of shell (considered as 1'00)	0'34
Height of penultimate whorl	: height of the spire (considered as 1'00) ...	0'20*
" " "	: its width (considered as 1'00)	0'68

In the smooth surface of the shell this species agrees with the jurassic *Fibulæ*, and its recent representative *Cerith. læve*, Q. and Gaim., which, as I have already remarked, is not a *Telescopium*, although the columella is nearly quite as tortuous as in the typical *Telesc. fuscum*.

The principal characters which distinguish our cretaceous species are the comparatively great height of the whorls as to their width and the occasional slight varices, which appear on the surface, being preceded by a deep furrow. Below the sutures all the whorls are somewhat contracted, the rest being slightly convex, and the last one obtusely angulated. The aperture is ovate, considerably narrowed towards each end, anteriorly terminating with a short canal, bent laterally, rather than recurved.

* If not otherwise stated I take these proportions on the back view of the shell, although the results do not very materially later if taken on the front view.

Locality.—In light coloured, gritty sandstone of Karapady in the Trichinopoly district; very rare.

Formation.—Arrialoer group.

2. *CERITHIUM* (FIBULA?) INAUGURATUM, *Stoliczka*. Pl. XV, Figs. 15, 19, 20.

Cerith. testa elongato-conica; anfractibus planis, spiraliter minutissime striatis, triliratis: lira posteriori juxta suturam posita, lata, crassa, 12-18 tuberculis in uno circuitu ornata; liris anticis duabus multo tenuioribus atque minute granulosis; ultimo anfractu antice abrupte contracto; basi applanata, obsolete striata, seu lævigata; apertura quadrangulari, antice canali brevi et lateraliter curvo terminante; columella solida, biplicata, plica antica multo crassiore, postica in junioribus speciminibus obsoleta.

Spiral angle 20° — 25° ; sutural angle 0° — 4°

Approximate height of last whorl : total of shell (considered as 1.00) 0.24

Height of penultimate whorl : height of spire (" ") 0.19

" " : its width (" ") 0.44

The more conical form, the angular and at the base less produced last whorl, the two thinner, only finely granulated, keels below a very strong one on the suture, ornamented with 12—18 tubercles, and the presence of at least two columellar plaits distinguish this species easily from *Cerith. hispidulum*. With respect to those characters, it approaches much more the Alpine-Gosau form *Cerith. hispidum*, Zek. (Abhandlg. d. Geol. Reichs-Anst., Wien, 1852, Vol. I, Pt. 2, pp. 115 and 116, Pl. XXIV, Figs. 1, 2 and 6, 7; Stoliczka, in Sitzgb. Akad. Wien, 1865, Vol. LII, Revision, etc., p. 110), but in this species only one thinner keel on each whorl and one median columellar fold is known. Unless it can be proved that both these forms show direct variations as regards these two points, they must be retained as distinct.

The more minute striation of the shell is very sharp in well preserved specimens, but it becomes easily obliterated. The tubercles show on the different keels great variations, and those on the posterior sutural keel occupy occasionally nearly half of the total height of one whorl (Fig. 20), while in other cases they are not so large, but more pointed (*vide* Fig. 19). Cast-specimens exhibit clearly the angular section of the whorls, but the columellar folds are not so easily traceable in young shells.

Localities.—Comarapolliam, Serganoor, and Karapady, in soft whitish sandstones; not rare at the first named locality; S. W. of Alundanapooram.

Formations.—Arrialoer and Trichinopoly groups; only the last named locality refers to the latter.

3. CERITHIUM (FIBULA ?) HISPIDULUM, *Stoliczka*, Pl. XV, Figs. 16, 17, 18.

Cerith. testa elongata, turrita; anfractibus regulariter in altitudine crescentibus, planis, postice prope suturam octonis seu denis tuberculis crassis atque acutis, et in tota superficie striis spiralibus granulosis ornatis, ultimis in ætate proejectiore postice sæpe obsoletis; basi ultimi anfractus, convexa, paulum producta atque spiraliter striato-sulcata; apertura ovali; labio calloso, lævigato, postice plicose-dentato; canali—?

Spiral angle 25° — 33° ; sutural angle 4° — 5° .

Height of last whorl	:	total of shell...	...	(considered as 1.00)	...	0.44
" of penultimate whorl	:	height of spire (	"	"	)	0.29
"	:	its width...	...	(	"	0.61

This species is distinguished by its strong and spinulose tubercles on the posterior margin of the whorls, the entire surface of which is covered with thin granulated spiral striæ. On the tubercles themselves these striæ become often obsolete, seldom so on the anterior flat portion of the whorls. On the produced basis of the last volution the striation and intermediate sulcation is stronger than elsewhere. The aperture could anteriorly terminate with only a short canal, but it has not been seen perfectly preserved. The inner lip is thickened, smooth, with only one elongated posterior tooth.

Localities.—S. of Serdamungalum, Kolakonuttom, and near Alundanapooram, all in soft light coloured sandstones; rather rare.

Formation.—Trichinopoly group.

4. CERITHIUM LIMBATUM, *Stoliczka*. Pl. XV, Figs. 13-(14 ?)

Cerith. testa elongata, turrita; anfractibus numerosis, suturis simplicibus, interdum undulatis sejunctis, planis, spiraliter minute et granulose striatis atque in parte anteriori duabus liris tuberculatis ornatis: tuberculis 12-14 in uno circuito, obtusis, spiraliter paulo elongatis, transversaliter costis obsoletis junctis, varicibus crassioribus nonnullis interpositis; basi ultimi anfractus paulo convexa, spiraliter striata, ad peripheriam obsolete tuberculate-carinata; apertura rotundate quadrangulari; labio lævigato, postice unidentato; canali—?

Spiral angle 23° ; sutural angle 8° — 10° .

Approximate height of last whorl	:	total of shell (considered as 1.00)	...	0.15
Height of penultimate whorl	:	height of spire (	"	0.16
"	:	its width (	"	0.47

A turreted subulate shell composed of a large number of flattened volutions, which are separated by simple, occasionally undulating, impressed sutures. The whole surface is covered with thin, finely granulated spiral striæ, and the anterior two-thirds portion of each whorl is ornamented with two strongly tuberculated spiral ridges, each two corresponding tubercles being transversally connected by an obsoletely marked rib, and only at some intervals by stronger varices. The ridges and tubercles are originally also striated, but these striæ are soon worn off, in which case they both

appear smooth, the tubercles being more or less rounded and somewhat prolonged in a spiral direction. The basis of the last whorl is only a little produced, slightly convex, and on the periphery bordered by an obsoletely tuberculated keel. The aperture was angular and somewhat roundish; the inner lip smooth, with an elongated posterior tooth; the canal has not been observed.

The very marked ornamentation easily distinguishes this species from others. In Fig. 14 on the same plate is represented a fragment of a large specimen from the white, soft sandstones near *Ninnyoor* (Trichinopoly district, Arriallor group). The form of the whorls, the character of the transverse ribs and of the spiral striation agree quite with those of the above species, and are different from any other shell, which we know from the South Indian cretaceous deposits. It is difficult to say, without actual observation of intermediate forms, that the spiral tuberculated bands of *Cerith. limbatum* ought to disappear without leaving even a trace of their former existence in more fully grown specimens; that, however, similar changes do often occur in other species of *Cerithium* is well known. Still we desire by figuring the said fragment merely to draw the attention of any future observer to this very interesting fossil.

Locality.—In light coloured sandstones near Coothoor; very rare.

Formation.—Arriallor group.

5. CERITHIUM CARNATICUM, *Stoliczka*. Pl. XVI, Figs. 1 and 2.

Cerith. testa ovale-elongata; anfractibus paucis, postice valde contractis, infra contractionem transversaliter tuberculata 8-13-costatis, spiraliter minute striatis; ultimo inflato, fere dimidium totius altitudinis testae formante; apertura ovata, utraque extremitate attenuata; labio postice arcuato, antice prope recto atque crasso et solido; canali—?

Spiral angle about 40°; sutural angle 6°—10°.

Height of last whorl : total of shell ... (considered as 1·00) ... 0·48

Height of penultimate whorl : height of spire (" " ") ... 0·37

" " " : its width ... (" " ") ... 0·49

The peculiar shape of the whorls, being much contracted posteriorly and each of them ornamented below this contraction with from 8—13 short tubercle-like transverse ribs, is very characteristic for this rare species. The surface of the shell is besides covered with fine spiral striæ, which, however, become easily obliterated with age, in which case the striæ of growth appear usually more strongly marked. The last whorl is remarkably high in proportion to the total height of the shell, and similar forms to these are only to be found in the genus *Cerithium* proper, for which reason we have placed this and the following species here, although the anterior canal of either is unknown.

The aperture of the present species is oval, pointed on both ends; the outer lip could not have been much expanded, but is not known in a perfect state; the inner lip was callose, arcuated, above the middle and anteriorly nearly quite straight, solid

and very thick, as may be seen in our Fig. 1, Pl. XVI. Judging from the cast the anterior canal could have been only short and very narrow.

Locality.—Near Veraghoor, in whitish sandstone; very rare.

Formation.—Arrialoor group.

6. CERITHIUM VAGANS, *Stoliczka*. Pl. XVI, Figs. 3 and 4.

Cerith. testa ovate-elongata, turrita, anfractibus septenis seu octonis composita, altis, postice multo angustioribus, in junioribus nonnunquam sublævigatis, prope suturam paulo tumescentibus, ad medium subcarinatis, infra carinam prope reclinatis, transversaliter 9-11-costatis, spiraliter postice duabus, antice ternis seu quaternis striis crassioribus atque nonnullis tenuioribus ornatis; ulla anfractu spiræ in altitudine fere æquante; apertura ovata, postice atque antice angustata; labio calloso, postice obtuse dentato; canali—?

Spiral angle 35° — 38° ; sutural angle 8° — 12°

Height of last whorl : total of shell (considered as 1.00) ... 0.49

Height of penultimate whorl : height of spire (considered as 1.00)... 0.40

" " " " : its width (" " ")... 0.53

In some specimens the posterior or contracted portion of the whorls is often quite smooth, except a thickened margin, while in others there are two stronger and some finer spiral striæ present. On the anterior or nearly perpendicular portion there are three or four striæ with or without any intermediate ones. The transverse ribs terminate either on the middle angle of the whorls, or they are somewhat more prolonged posteriorly, but always much less marked. The aperture is considerably narrowed on both ends, and anteriorly produced; the canal has not, however, been seen perfect, but it must have been only very short. The inner lip is strongly callose, with a posterior tooth.

As to form and ornamentation this species resembles *Cerith. Stoddardi*, Hislop, from the so called intertrappean beds near Rajamundry (Quar. Journ. Geol. Soc. Lond., XVI, p. 177, Pl. VIII, Fig. 35). It differs from that species chiefly by the unequal strength of the spiral striæ and by having the transversal tubercles on the different volutions corresponding to each other in almost perpendicular lines, while in *Cerith. Stoddardi* the tubercles correspond to each other in very oblique lines and the spiral striæ are more numerous and almost all of the same thickness.

Localities.—Garudamungalum, in a blueish, calcareous sandstone, and Kara-paudy, in whitish, soft sandstone; rare.

Formations.—Trichinopoly and Arrialoor groups.

7. CERITHIUM ARCOTENSE, *Stoliczka*. Pl. XV, Figs. 2—5.

Cerith. testa conica, elongata, spira subulata, in medio atque antice subcylindrica; anfractibus numerosis, planiusculis, liris spiralibus alternatim crassioribus atque costulis transversalibus obliquis granulosisque ornatis, ultimis varicibus plus minusve numerosis interruptis, granis in serie posteriori juxta suturam positis multo fortioribus quam ceteris et nonnunquam linea impressa spirali rursus divis; costulis lirisque infra seu antice semper tenuioribus atque interdum in anfractibus ultimis omnino obsoletis; apertura ovali, in utraque extremitate angustata; labro paulo expanso, extus varicoso, intus laevigato; labio postice uni-dentato; canali brevi atque angusto.

Spiral angle 25° — 30° ; sutural angle 12° — 13°

Height of last whorl : total of shell (consd. as 1·00) 0·31

Height of penultimate whorl : height of the spire (consd. as 1·00) 0·17

" " " : its width (consd. as 1·00) 0·54—0·58

This elongated conical shell consists always of a large number of flattened volutions, the first few of which form a subulate apex, and begin to grow with an angle of 25 — 30 degrees, becoming subsequently almost cylindrical in shape. Each of the whorls is ornamented with a number of oblique, transverse ribs, interrupted at some distances by thicker varices, and with four or five spiral striæ, which usually alternate in their strength, and produce a granulation on the former. The posterior series of these granules is always the strongest, the following series become gradually smaller, and towards the last volution all the ornamentation gets often more or less obsolete. The last whorl shows occasionally a little irregularity in its coiling by descending somewhat lower. The aperture is oval, posteriorly acute, and considerably narrowed by a strong fold-like tooth on the inner lip, and terminating anteriorly with a short, slightly bent canal. The outer lip is somewhat expanded, and thickened exteriorly so as to form a varix.

This species has rather more the general form of *Vertagus*, but there is no trace of a fold on the columella, which is only sharpened where it terminates on the anterior canal. It approaches in ornamentation and form very much to the *Cerith. rude*, Sow. (D'Archiac, Gr. Numm. de l'Inde, p. 299, Pl. XXVIII, Figs. 9—12) from the nummulitic deposits of Scinde. The latter species has, however, the transverse ribs nearly always equally strong in their total length, and the tubercles are more rounded than spirally elongated.

Localities.—N. E. of Anapaudy (white sandstones); near Veraghoor (yellowish sandstones); and near Coothoor, in a whitish siliceous sandstone; very common.

Formation.—Arrialoor group.

8. *CERITHIUM LASSULUM*, *Stoliczka*. Pl. XV, Fig. 8, Pl. XIX, Fig. 1.

Cerith. testa turrita ; anfractibus numerosis, planulatis, sutura profunda sejunctis, spiraliter minute striatis atque seriebus ternis tubercularum fere æqualium ornatis, in interstitiis paululum crenulatis ; basi ultimi anfractus applanata, spiraliter striata, ad peripheriam carinata ; apertura rotundate-angulari ; canali brevi ?

Spiral angle 21° ; sutural angle 10°.

Height of one whorl : its width (considered as 1·00) ... 0·5.

There are two cretaceous species known, which greatly resemble our Indian fossil in ornamentation, namely, *Cerith. ternatum*, Reuss (Boehm. Kreide. 1845, pt. I, p. 42, Pl. X, Fig. 3), and *Cerith. sociale*, Zek. (Abhandlg. Geol. Reichs-Anst. Wien, 1852, Vol. I, Pt. II, p. 95, Pl. XVII, Figs. 4 and 6 ; *Stoliczka*, in *Sitzungsb. Akad. Wien*, 1865, LII, Revision, etc., p. 95). Of the former, which is from the Bohemian cretaceous deposits, Prof. Reuss says, that the middle row of tubercles is stronger than any of the others, while in our specimen they are nearly equal in strength, the lowest being comparatively the strongest. The sutures are also much wider in our species, and the entire shell is covered with fine spiral striæ, of which, however, often only one between each row of tubercles remains preserved, and occasionally they all disappear.

The *Cerith. sociale* is from the Alpine Gosau-deposits, and differs by its more slender form, posteriorly abruptly terminating whorls, and produced basis of the last, being ornamented with three or four strong ridges.

Locality.—Vylapaudy, in yellowish sandstones ; very rare.

Formation.—Arriallor group.

9. *CERITHIUM CLARANDUM*, *Stoliczka*. Pl. XV, Fig. 10.

Cerith. testa subulata ; anfractibus numerosis, sutura angustissima sejunctis, planis, spiraliter ternis liris acutiusculis, transversaliter 12-14 costulis decussantibus atque tubercula spinulosa formantibus ornatis ; liris aliquantisper striis tenuissimis alternantibus ; apertura quadrangulari.

Spiral angle 17° ; sutural angle 7°.

Height of one whorl : its width (considered as 1·00) ... 0·32

The ornamentation of this species is so characteristic that, imperfect as the specimen is, it can be easily recognised. Generally there is only one thin intermediate line between the two lower or anterior ridges, and one above the posterior running along the suture. There is, however, from the same locality another larger but less perfect specimen, which has four equally strong and closely placed spiral ridges, and the transverse ribs somewhat stronger on each whorl. The uppermost volutions are not preserved, the spiral angle of the lower ones is 22°. It is difficult to say whether this form depends only upon a variation in the surface markings, or whether

these indicate another species, which would somewhat resemble *Cerith. Requierianum*, D'Orb. (Pal. Franç. crét. II. Pl. 232, Figs. 4 and 5). The latter supposition is more probable. I could only recall on this occasion D'Orbigny's *Cerith. Fontanieri* (Astrol. Pal. Pl. IV, Fig. 2) from Pondicherry, in which species the spiral striae are still more numerous.

• *Locality*.—Anapaudy, in yellowish calcareous sandstone; very rare.

Formation.—Trichinopoly group.

10. CERITHIUM TRIMONILE, *Michelin*. Pl. XV, Fig. 9, and Pl. XIX, Figs. 2 and 3.

1838. *Cerith. trimonile*, Mich. Mem. Soc. Géol. France, Ire. ser. Vol. III, p. 100, Pl. XII, Fig. 5.

1842. „ „ D'Orbigny, Pal. Franç. crét. II, p. 369, Pl. 230, Figs. 7—9.

Cerith. testa turrita, apice subulata; anfractibus complanatis, spiraliter minute striatis atque ternis sericibus tuberculorum ornatis: tuberculis in serie mediana sæpius ceteris minoribus, serie superna vel posteriore interdum sulca profunda duabus inferioribus sejuncta, tuberculis in serie antica sæpissime maxime elevatis; basi ultimi anfractus subconvexa, moderate producta, spiraliter striata; apertura quadrangulari, antice canali contorto sed angustissimo terminante; labio lævigato.

Spiral angle 25° — 30° ; sutural angle 4° — 5°

Height of last whorl :	total of shell	...	(considered as 1'00)...	...	0'32
„ of penultimate whorl :	height of spire (	„	„ „ )...	...	0'24
„ „ „ „ :	its width	...	(„ „ „)...	...	0'17

A small subulate shell composed of numerous flattened volutions, which increase very gradually and regularly in height and width. Each of the whorls is ornamented with three rows of small, rounded, and closely-set tubercles. In young specimens the uppermost or posterior row is always distinctly separated by a deep furrow, while the tubercles in the two others approach so very nearly to each other, that they seem to form short transversal ribs. In larger grown specimens this furrow remains either equally distinct or becomes more obliterate. The middle row has generally the smallest and the anterior the largest tubercles. Very seldom the tubercles of the two anterior rows are nearly equal, and not so strong as those on the posterior. Besides these tuberculated ridges the entire shell-surface is minutely striated. The canal is contorted and tolerably produced; the aperture quadrangular and the lips smooth.

Michelin's original figure is not very clear. D'Orbigny figures a specimen in which the tubercles of the posterior row are the smallest, and of which the spiral angle is 32° ; the first case has never been observed in our specimens, and their largest spiral angle does not exceed 30° . In every respect, however, our specimens are identical with originals from the Gault of Yonne, transmitted to us very kindly by Prof. Pictet. It adds very much to the interest of our fauna, that this characteristic Gault fossil occurs also in the South Indian cretaceous deposits. It belongs here to the highest group of the series. The species is common in the Gault of France, and has also been found near Folkstone.

Localities.—N. E. of Karapaudy and N. of Comarapolliam, in whitish siliceous sandstones; not very common.

Formation.—Arriallor group.

11. CERITHIUM FERTILE, *Stoliczka*. Pl. XV, Figs. 11 and 12, and Pl. XIX, Fig. 5.

Cerith. testa conica; anfractibus paulo excavatis, spiraliter minute-striatis, antice et postice atque prope medium crenulate-carinatis: carina suturali posteriori multo fortiori, mediana minima; apertura quadrangulari, antice canali brevi terminante; labio lævigato; columella contorta.

Spiral angle about 40° ; sutural angle 1° — 4°

Height of last whorl	:	total of shell (considered as 1'00)	...	...	0'28
"	"	penultimate whorl	:	height of spire (considered as 1'00)	0'15
"	"	"	:	its width (" " ")	0'14

This species is one out of a large number of very similar forms known from the cretaceous deposits of Europe, namely, *Cerith. Derignyanum*, *Rhodani*, and *Sabaudianum*, of Pictet and Roux., *Cerith. Mosense*, Buvignier, *Cerith. ornatissimum*, D'Orb., *Cerith. Chavannesi*, Pictet and Campiche, and some others. The nearest allies are certainly *Cerith. Mosense* and *ornatissimum*, which are stated by Pictet to be undoubtedly different species (*vide* Mat. p. l. Pal. Suisse, ser. III, p. 294). From both these, certainly very similar species, our Indian fossil differs by a greater height of the whorls as compared with their respective width. The spiral angle approaches very nearly, or is often exactly, the same as in *Cerith. ornatissimum*. There is no marked difference between the posterior keels of the two species. But while in *C. ornatissimum* the anterior keel separates a small distance from the suture, when on the last whorls approaching the aperture, the same is in *Cerith. fertile* always strictly sutural, but much stronger than the anterior; and in addition to the middle keel there is a fourth one present, and quite distinct in young specimens, gradually becoming obliterate in older. (*Vide* Pl. XIX, Fig. 5.) These differences are therefore greater than those between the two above-mentioned European species.

It is important also to mention the Transylvanian species, which I have noted as *Cerith. rotulare* in the Jahrb. Geol. Reichs-Anst. Wien, 1863, Vol. XIII, p. 51. This species is a much more slender form, and differs from *Cerith. Mosense* apparently only by the very considerable thickness of the shell and more concave whorls.

Casts of *Cerith. fertile* are quite smooth; the aperture is quadrangular, wider than high, terminating anteriorly in a short, laterally bent canal.

Locality.—N. of Odium, in yellowish, calcareous sandstone with *Am. inflatus*, *dispar*, and others.

Formation.—Ootatoor group. It is interesting to see that this species occurs with precisely the same association of *Ammonites* as the similar forms to which I alluded occur in Europe, while their other associate Gault-species, *Cerith. trimonile*, has as yet been found in India only in the highest beds.

12. CERITHIUM (EXELISSA ?) SCALAROIDEUM, Forbes. Pl. XV, Figs. 6 and 7.

1846. *Cerith. scalaroideum*, Forbes, Trans. Geol. Soc. Lond., ser. II, vol. VII, p. 125, Pl. XIII Fig. 7.

Cerith. testa turrita; anfractibus circiter denis, planatis, suturis latis atque profundis sejunctis, transversim 14-16-costulatis, spiraliter 4-liratis: liris tenuibus atque in costulis tubercula plus minusve elata seu acuta formantibus; superficie omnina spiraliter minutissime striata; costulis prope aperturam in striis numerosis elevatis dissolutis; apertura circulari, marginibus conjunctis, paulo elevatis, antice canali brevi atque angustissimo, contorto terminantibus; basi ultimi anfractus prope peripheriam bicarinata, ad medium excavata atque prope terminationem canalis unicarinata; carinis omnibus crenulatis, crassis.

Spiral angle (on the top whorls only) 30° — 32° ; sutural angle 12° — 14°

Height of last whorl . total of shell (considered as 1.00) 0.42

,, of penultimate whorl . height of spire (considered as 1.00) 0.25

,, ,, ,, ,, : its width (,, ,, ,,) 0.47

The shell begins to grow with an angle of about 32° , but after it has reached a certain size, the whorls do not increase to the same extent proportionally in width, and the form becomes therefore more cylindrical. The transverse ribs are always thin, oblique in the direction of the outer lip, and near the aperture they become replaced by a large number of merely elevated lines. Their number varies between 12 and 16; 14 being about the usual number. Spiral ridges seem to be always only four; the tubercles, which are formed by them in crossing the transverse ribs, are generally sharpened and pointed, seldom they appear so much rounded, as represented in our Fig. 6, Pl. XV. The entire surface of the shell is minutely spirally striated. The aperture is circular, its margins somewhat elevated and separated from the other shell, forming a kind of a tube and terminating anteriorly with a short, contorted, and exceedingly narrow canal.

I need scarcely repeat here again, what I have already stated at length about Piette's genus *Exelissa*. The only species that has really a very great resemblance to our Indian fossil is one figured and described by Reuss (Boehm. Kreide. 1846, Pt. I, p. 42, Pl. X, Fig. 5, and Pl. XI, Fig. 22) as *Cerith. reticulatum* (? Sow.*) from the cretaceous conglomerate of Meronitz in Bohemia. I would almost believe that they are identical. Geinitz identifies that *C. reticulatum* of Reuss with *Cerith. imbricatum*, Geinitz,† (*vide* Quadersandsteingebirge, 1849-50, p. 142), but upon a reference to Geinitz's original figure in his "Characteristic des Sächs. Boehm. Kreidegeb." Pt. III, 1842, p. 72, Pl. XVIII, Fig. 22, such an identification is very objectionable, unless Geinitz's figure be quite incorrect. This specimen of *Cer. imbricatum* has the whorls separated by very narrow sutures, the transverse ribs are

* The name *C. reticulatum* has been used repeatedly by several authors, as Montagu, Risso, Deslonchamps, &c.

† This name cannot stand, for it has been equally used a long time ago by Bruguiere, Bonelli, and others. Munster's *Cerith. imbricatum* (in Goldf. Pet. Germ.) is called by Geinitz; *C. Goldfussi* (non idem, Zekehl.)=*C. reticosum*, Sow. (*vide* Stoliczka in Sitz. Akad. Wien, 1865, Vol. LII, Revision, etc., p. 97). D'Orbigny, in Prodrome II, p. 231, calls the same *C. sub-imbricatum*.

very broad, the spiral ridges close to each other and more numerous. Geinitz's description is not clear on these points. I am unable to refer to Woodward's Geology of Norfolk, which Prof. Reuss quotes, but I cannot find that name of Sowerby in D'Orbigny's, Bronn's, or Morris' catalogues.

Localities.—Near Alundanapooram, in blueish calcareous and shelly sandstones; the species is rare, but it occurs oftener near Arrialore and Comarapolliam in whitish soft sandstones. From a similar sandstone there are two specimens labelled in the Madras Museum as from Pondicherry; if so, they must have been got there from the upper or Arrialore beds, pointed out by Mr. H. Blanford.

Formations.—Trichinopoly and Arrialore groups; to the former the first named locality refers.

13. *CERITHIUM* (SANDBERGERIA) *ANTECEDENS*, *Stoliczka*. Pl. XVI, Fig. 5, and Pl. XIX, Fig. 4.

Cerith. testa turrita; anfractibus decem seu duodenis, convexis, transversaliter obsolete costulatis spiraliter liris: liris medianis tenuioribus alternantibus atque omnibus in costulis transversalibus spinulosis seu subtuberculatis; apertura ovate-rotundata, antice paulo producta atque late effusa, marginibus integris, parum dilatatis, intus lævigatis; labro extus varicoso.

Spiral angle 40°—42°, sutural angle 4°—5°			
Height of last whorl :	total of shell (considered as 1 00)	...	0 40
„ of penultimate whorl :	height of spire (considered as 1 00)	0 30	
„ „ „ :	its width (considered as 1 00)	...	0 48

The transverse ribs are always very thin, and often only apparent through the fine tubercles, which are formed by the spiral striæ. Of the latter six are generally stronger, and except those running along either of the sutures the others alternate with finer striæ. Those on the greatest convexity of the whorls are, generally speaking, the strongest. The margins of the aperture are united posteriorly, somewhat expanded, internally smooth; and the outer lip is externally varicose. A second varix is occasionally preserved in larger grown specimens, and placed at about two-thirds the distance of the volution from the aperture. On the place of the anterior canal the margins are only somewhat produced and form a broadly effuse channel.

An allied species is *Cerith. Lallierianum*, D. Orb. (Pal. Franç. cré. II, Pl. 229, Figs. 7-9), which differs merely by stronger transversal ribbings, somewhat more numerous spiral striæ and more produced anterior canal. Forms very similar to the Indian fossil are to be found among living American and Indian species of *Cerithidea*, like *C. Mazatlanica*, Carp., *C. Mörchii*, Adams, *C. iostoma*, Pfeiff., and others (*vide* Reeve, Conch. Icon., Monog. of *Cerithidea*, 1866); we have, however, already referred to the probable distinctions between *Sandbergeria* and *Cerithidea*.

Localities.—Karapaudy, N. E. of Shillagoody, and east of Andoor, in soft conglomeratic sandstones.

Formation.—Arrialore group.

14. CERITHIUM (SANDBERGERIA ?) CRISPICANS, *Stoliczka*. Pl. XVI, Figs. 6—8.

Cerith. testa turrita; anfractibus octonis seu denis, convexis, transversaliter 10-18-costulatis, spiraliter liris: costulis in speciminibus adultis plus, in junioribus minus numerosis; liris in quoque anfractu, septenis seu nonis nonnunquam fere aequalibus, sæpius nonnullis alteris multo tenuioribus alternantibus, paulo undulatis seu crispatis; apertura ovata antice effusa; labio lævigato, tenui.

Spiral angle 30° — 35° ; sutural angle 7° — 8°

Height of last whorl	:	total of shell	...	(considered as 1.00)	...	...	0.42
„	of penultimate whorl	:	height of spire	( „ „ „ )	...	...	0.31
„	„	„	its width	... ( „ „ „ )	...	...	0.44

A small turreted shell, which numbers from eight to ten convex whorls, each being ornamented by 10-18 transverse ribs and 7-9 spiral, sharp, and slightly undulating ridges. In young specimens the ribs are less numerous, and increase gradually with the size of the whorls. The spiral ridges are sometimes nearly equal, but more frequently some of them, especially the middle ones, alternate with finer ridges, which also cover the basis of the last volution.

The aperture is oval, anteriorly somewhat produced and effuse. It has not been seen quite perfect in a full grown specimen. The small one represented on Plate XVI, Fig. 6, although having the shell surface somewhat obliterated, has a thin but distinct varix on the outer lip externally; no varix has been observed on any of the preceding whorls. The inner lip is comparatively thin and smooth.

Until good and full grown specimens of this species have been found, its determination as *Sandbergeria* must remain doubtful, although the great similarity between the same and the *Cerithium antecedens* makes it very probable. I am not acquainted with any cretaceous species which could strictly be compared with the above.

Localities.—East of Alundanapooram and near Arrialore, in soft, whitish sandstones; rare.

Formation.—Arrialore group.

PLATE I.

- Figs. 1—5.** *ANCHISTOMA CRETACEUM*, *Stol.*; p. 9; 1, front view of a small specimen showing the teeth of the inner lip; 2, basal view of the interior whorls of a larger specimen, to exhibit the sharp edge round the umbilicus in the young shell; 3, and 3 *a*, upper-and front-views of a nearly complete specimen, and 3 *b*, the exterior termination of the last whorl to show the dentition of the outer lip; 4, front-and basal-views of a much depressed specimen; 5, front-and upper-views of a complete specimen; 5 *a*, showing the lateral depression of the last whorl near the aperture. All the figures are enlarged twice, and the natural size is given in the accompanying cross-lines representing the diameter and the height; all specimens are from near *Comarapolliam* (N. of Arrialore), in the *Arrialore group*.
- Fig. ... 6.** *ANCHISTOMA ARRIALORENSE*, *Stol.*; p. 10; upper-front-and basal-views of a specimen of twice the natural measurements, the shell surface is partly not preserved, and the probable shape of the aperture is restored in outline; from *Ninnyoor*, in the *Arrialore group*.
- Fig. ... 7.** *ANCHISTOMA ARCOTENSE*, *Stol.*; p. 11; 7, 7*a*, 7*b*, upper, basal-and front-views; 7*c*, lateral view of the last whorl (with the shell taken off) to show the form of the single tooth on the outer lip; the figures are enlarged to twice the actual measurements, which are given by cross-lines; from *Alundanapooram*, *Trichinopoly group*.
- Fig. ... 8.** *MACROCYLIS CARNATICA*, *Stol.*; p. 12; 8 and 8*a*, upper-and front-views of a somewhat mutilated specimen; 8*b*, is a restored outline of the probable shape of the specimen, and the difference in the thickness of these two is given in the accompanying cross-lines; the specimen is figured of the natural size; from near *Feraghoo*, in the *Arrialore group*.

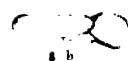
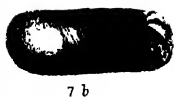


PLATE II.

- Fig. ... 1. *APORRHAI\$ ARRIALOORENSIS*, *Stol.*; p. 28; 1 and 1 *a*, front-and back-views, enlarged to twice the linear dimensions; the wanting parts of the wing have been restored in outline; *Comarapolliam*; *Arrialore group*.
- Figs. 2—4. *APORRHAI\$ SECURIFERA*, *Forbes*, sp.; p. 28; 2—2*a*, front and back-views of a nearly complete specimen; 4, front-view of a large fragment, with much thickened internal margins of the aperture; both specimens from near *Alundunapooram*; 3, an imperfect specimen with somewhat more convex whorls and a fine spiral striation; from *Kolakonuttom*; *Trichinopoly group*.
- Figs. 5—8. *ALARIA PARKINSONI*, *Mant.* sp.; p. 30; 5, front-view of a cast with the impression of the wing; 6, back-view of another specimen, with the posterior outline of the wing; both from near *Odium*; *Ootalore group*; 7, small specimen with smooth embryonal whorls from *N. of Serdamungalum*, and 8, front-view of an incomplete specimen from *S. of Serdamungalum*; *Trichinopoly group*.
- Figs. 9—10. *ALARIA PAPILIONACEA*, *Goldf.* sp.; p. 31; 9, back-view of a specimen from *N. of Serdamungalum*, and 10, front-view of a specimen from near *Coonum*; *Trichinopoly group*.
- Figs. 11—13. *ALARIA TIGULATA*, *Stol.*; p. 33; 11—11*a*, front and back-views of an incomplete specimen with numerous thin ribs; from *Olapaudy*; *Arrialore group*; 12, front-view of a specimen with somewhat larger spiral angle, wing and anterior canal broken away; 13, back-view of another incomplete specimen with moderately distant and continuous ribs; the last two from near *Kolakonuttom*; *Trichinopoly group*.
- Figs. 14—15. *ALARIA GLANDINA*, *Stol.*; p. 32; 14—14*a*, front and back-views of a nearly complete specimen, and 15, front-view of a larger, but incomplete specimen; both from near *Anapaudy*; *Trichinopoly group*.
- Figs. 16—17. *ALARIA ACICULARIS*, *Stol.*; p. 32; 16—16*a*, front and back-views, and 17, back-view of incomplete specimens; both from *Olapaudy*; *Arrialore group*.
- Figs. 18—20. *ROSTELLARIA PALLIATA*, *Forbes*, p. 34; 18—18*a*, front and back-views of a cast specimen from *S. of Serdamungalum*; *Trichinopoly group*; 19,* an imperfect specimen from near *Pondicherry* (?) *Valudayur group*; 20—20*a*, back and front-views of a specimen from *Olapaudy*; *Arrialore group*; the probable shape of the outer lips has been completed in outline, which ought to indicate anteriorly a more distinct notch.

* This specimen is in the Madras Collection.

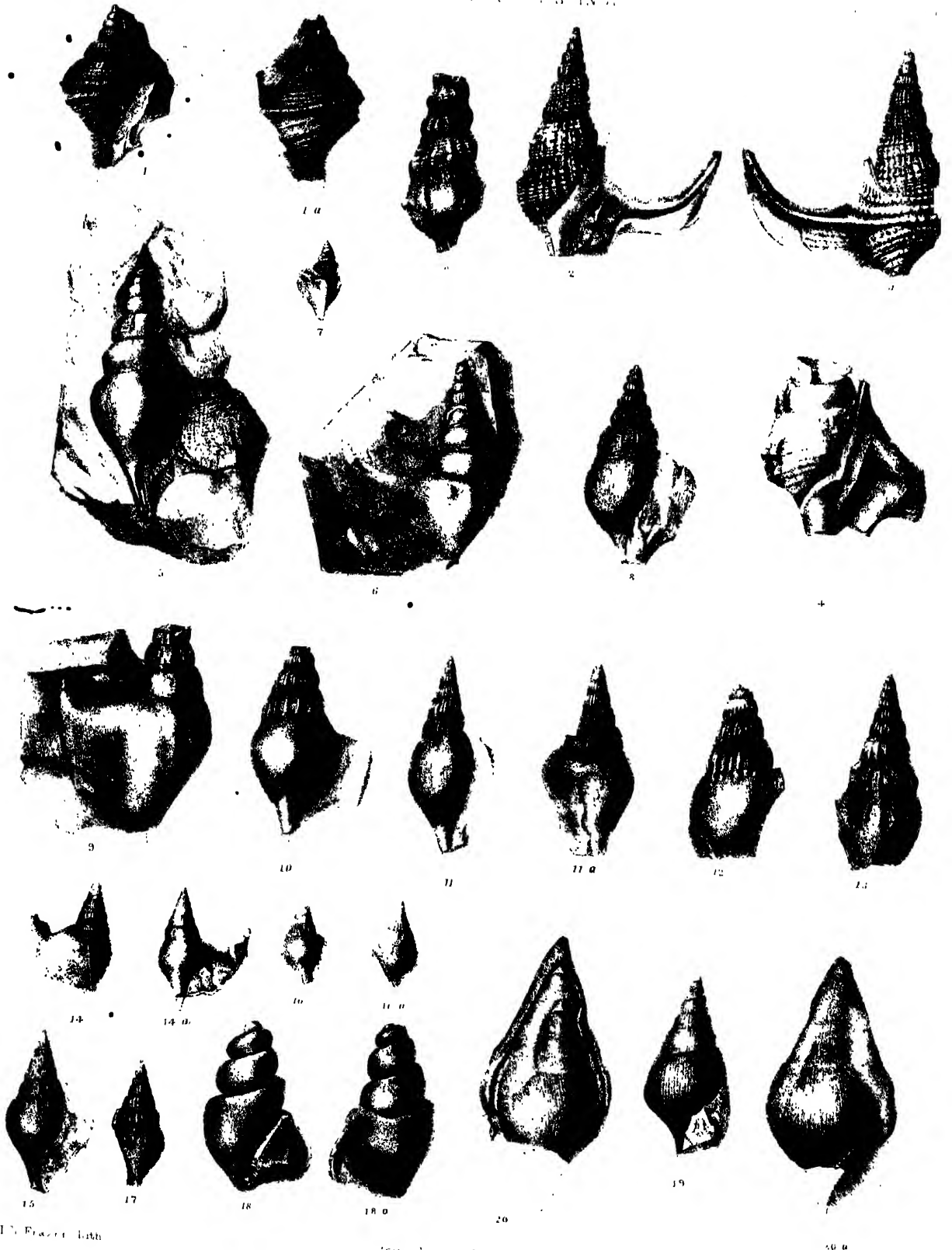


PLATE III.

- Figs. 1—5.** *PUGNELLUS CONTORTUS*, *Sow.*, sp.; p. 19; 1—1*d*, different views of a complete specimen; 2, front-view of an imperfect specimen; 3, ditto of a cast; 4, back-view of a cast-specimen with the greater portion of the last whorl, but without the margins of the aperture; 5—5*a*, front-and back-views of an incomplete specimen, with numerous and thin transverse ribs; all specimens from *N. of Alundana-pooram*; *Trichinopoly* group.
- Figs. 6—8.** *PUGNELLUS GRANULIFERUS*, *Stol.*; p. 21; 6-6*a*, front-and back-views of an incomplete specimen from *S. of Serdamungalum*; 7, back-view of a nearly complete cast from *Anapandy*; both these localities are in the *Trichinopoly* group; 8, different views of a large specimen from *W. of Illpagoody*; the anterior termination of the canal has been restored in outline; *Arrialoor* group.
- Figs. 9—13.** *PUGNELLUS UNCATUS*, *Forbes*; p. 22; 9—9*d*, different views of a nearly full grown, complete specimen; 10, front-view of an incomplete, but larger specimen with enveloped spire; 12 and 13, front and back-views of cast specimens; all these are from near *Arrialoor* in the *Arrialoor* group; 11 is a front-view of an incomplete specimen from near *Pondicherry* in the *Trichinopoly* group.

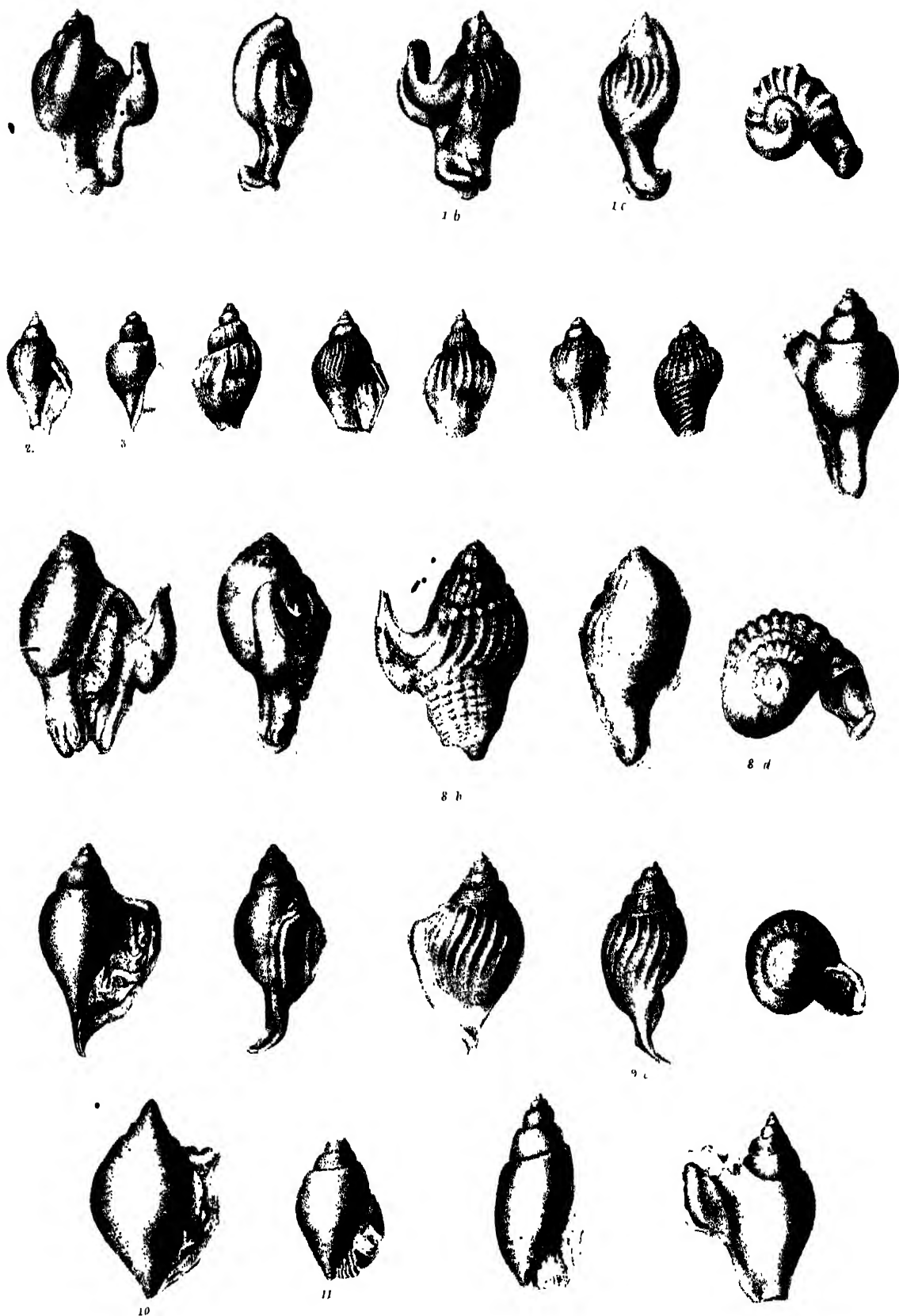


PLATE IV.

- Fig. ... 1. *OVULA ANTIQUATA*, *D'Orb.*; p. 47; 1, front-, 1 *a*, back-, 1 *b*, posterior-views; from *Arrialoor*; *Arrialoor group*.
- Figs. 2—3. *CYPRÆA (LUPONIA) NEWBOLDI*, *Forb.*; p. 54; 2, back-, 2*a*, front-, 2*b*, posterior-views of a well preserved specimen from near *Audoor*; 3, front-view of a cast from *W. of Kullygoody*; all from a light coloured gritty sandstone of the *Trichinopoly group*, but close to the boundary of the *Arrialoor group*.
- Fig. ... 4. *CYPRÆA (LUPONIA) CUNLIFFI*, *Forb.*; p. 55; 4, front-, 4*b*, posterior-, 4*a*, back-views of a specimen, partly completed from another; near *Veraghoor* in the *Arrialoor group*.
- Fig. ... 5. *CYPRÆA (LUPONIA) PILULOSA*, *Stol.*; p. 53; 5, front-, 5 *b*, posterior-, 5 *a*, back-views of a specimen from near *Moraviatoor* in the *Ootatoor group*.
- Fig. ... 6. *CYPRÆA (?) EPONA) ANOMALA*, *Stol.*; p. 56; 6, front-, 6 *b*, posterior-, 6 *a*, back-views of a specimen, which on the posterior portion is devoid of shell; from near *Vylapandy*; *Arrialoor group*.
- Figs. 7—10. *CYPRÆA KAYEI*, *Forbes*; p. 56; 7, front-view of a specimen from near *Audoor*; *Trichinopoly group*; it has the callose inner lip partly preserved, and shows the dentition; 8 and 10 are specimens from the *S. of Serdamungalum (Trich. group)*; they are casts without a trace of shell; 9 is a representation of a specimen from near *Arrialoor (Arr. group)*; it is equally a cast, but traces of dentition are perceptible on the inner marginal impression of the outer lip.
- Figs. 11—12. *CYPRÆA (ARICIA) PICULINA*, *Stol.*; p. 53; 11, front- and posterior-views of a young specimen from the sandstones *W. of Kullygoody (Trich. group)*; 12, front-, posterior-, and back-views of a larger specimen from *Alundanapooram (Trich. group)*; the probable shape of the specimen has been restored in outline.
- Figs. 13—14. *ERATO VERAGHOORENSIS*, *Stol.*; p. 59; 13—13 *b*, front-, posterior-, and back-views of a young specimen, and 14—14 *b*, the corresponding views of an apparently full grown specimen; the wanting portions have been restored in outline to their probable shape; both specimens from the *Arrialoor beds near Veraghoor*, occurring in light coloured sandstones.

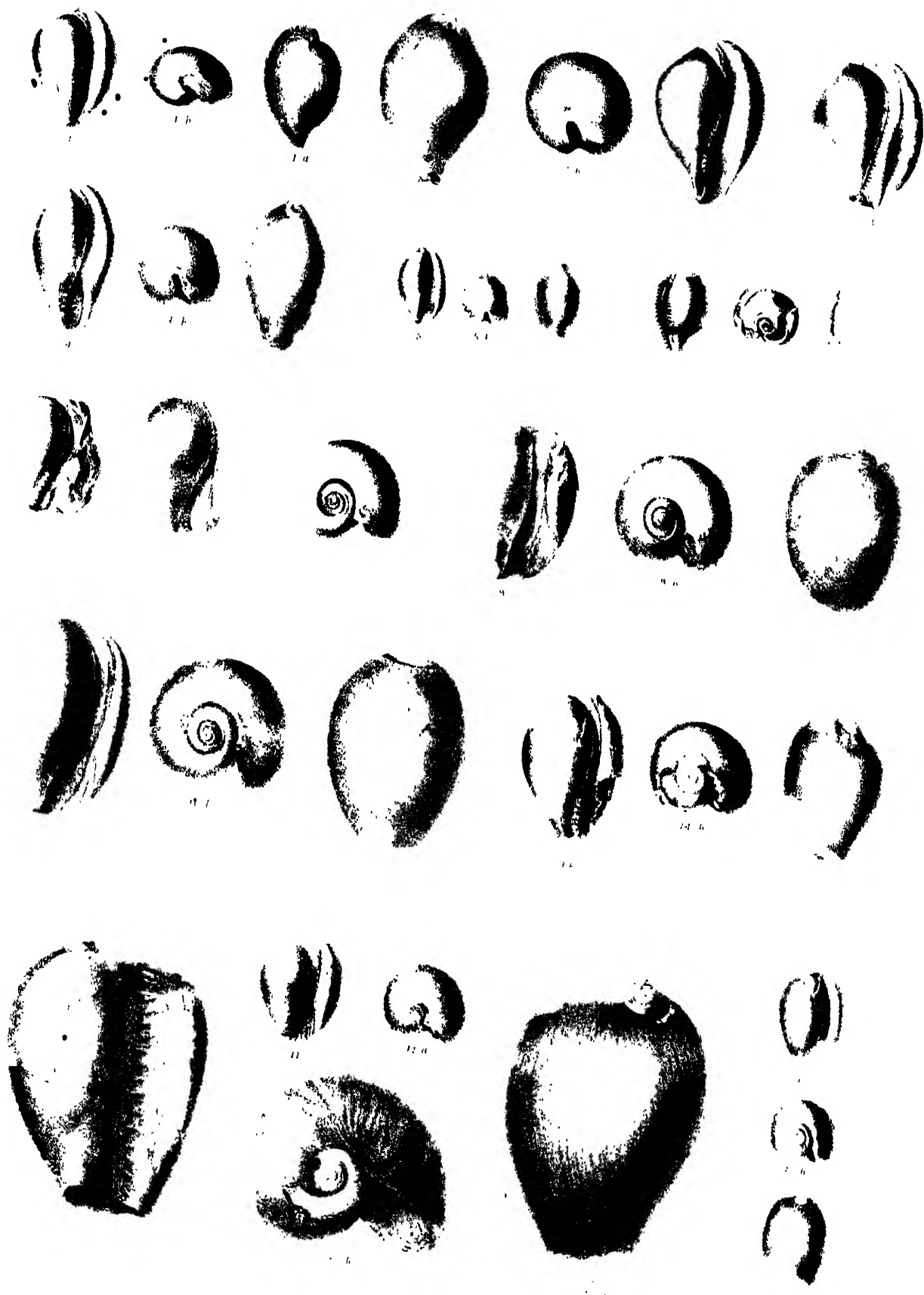


PLATE V.

- Figs. 1 and 3.*** *PTERODONTA OOTATOORENSIS*, *Stol.*; p. 43; 1-1*a*, front-and back-views of a large specimen, the front side being devoid of the shell surface, and showing a few marginal impressions on the upper whorls; 3, front-and top-views of a cast; the section of the aperture is taken through the internal thickening of the outer lip; both from near *Odium*; *Ootatoor group*.
- Figs. 2 and 4.** *PTERODONTA NOBILIS*, *Stol.*; p. 43; 2-2*a*, front-and back-views; in the former the shell is perfect on the last whorl; 4 is a cast showing the disposition of the impressions; both from *Garudamungalum*; *Trichinopoly group*.
- Fig. ... 5.** *PTERODONTA BULIMOTIDES*, *Stol.*; p. 42; front-and back-views of a young, but apparently complete specimen; the shell surface is preserved, except in 5 *b*, on a portion of the last whorl; *Veraghoor*; *Arrialoor group*.
- Fig. 6—8.** *PTERODONTA? TEREBRALIS*, *Stol.*; p. 42; 6, front-view of an imperfect specimen, on which the smooth shell surface is partially preserved; 7 and 8, front-views of casts; the former showing the two columellar plaits distinctly, and the latter the lengths of the canal; near *Odium*; *Ootatoor group*.
- Fig. ... 9.** *ONISCIA COSTELLATA*, *Stol.*; p. 63; front-, side-, and back-views of a nearly complete specimen from the sandstones *S. of Arrialoor*; *Arrialoor group*.
- Fig. ... 10.** *CYTHARA CRETACEA*, *Stol.*; p. 66; front-, side-, back-, and top-views of a specimen, on the last whorl of which the shell is mostly well preserved; *Veraghoor*; *Arrialoor group*.

* p. 43, line 12 from below, read Figs. 1 and 3, instead of, Figs. 1—3.

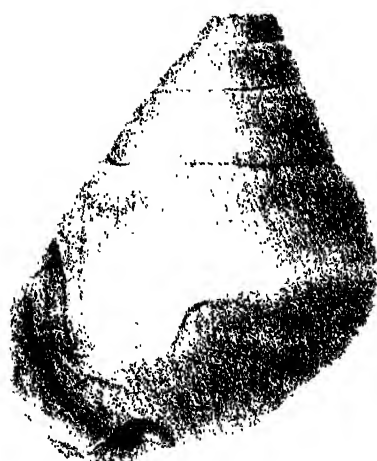


PLATE VI.

- Figs. 1—2. *PLEUROTOMA SUBFUSIFORMIS*, *D'Orb.*; p. 69; 1, front-view of a specimen with perfect anterior canal, the outer lip restored in outline; 2, side-view of another specimen, showing the insinuation and the posterior portion of the outer lip perfect; both from near *Andoor*; *Trichinopoly* group.
- Figs. 3, 7, 8. *GOSAVIA INDICA*, *Stol.*; p. 73; 3-3a, front-and side-views of a nearly perfect, small specimen; 7, front-view of a large specimen showing the disposition of the folds on the inner lip; the probable shape is marked in outline; both specimens are from a whitish sandstone *between Andoor and Veraghoor*; 8, back-view of a specimen from a similar sandstone *W. of Kullygoody*; the shell surface is only partially preserved, but exhibits clearly the spiral striation, specially on the keel; *Trichinopoly*-, if not *Arrialoore*-group.
- Figs. 4—5. *SCAPHA ATTENUATA*, *Stol.*; p. 82; 4, front-view of a specimen nearly complete, as regards form, but the shell surface is a little worn off; 5, back-view of another specimen, on which the surface is better preserved; *Kolakonuttom*; *Trichinopoly*-group.
- Fig. ... 6. *SCAPHA GRAVIDA*, *Stol.*; p. 82; front-view of a specimen from *Ninnyoor*; the outer lip and anterior termination have been restored in outline; *Arrialoore* group.
- Fig. ... 9. *MELO PYRIFORMIS*, *Forbes*, sp.; p. 83; 9-9a, front-and back-views of a nearly complete specimen; only a small portion of the shell near the anterior termination having been restored from another; from a softish light coloured sandstone near *Pondicherry*?; *Valudayur*-, or more probably *Arrialoore* group.
- Figs. 10—11. *FICULOPSIS PONDICHERRIENSIS*, *Forbes*, sp.; p. 85; 10, front-view of an imperfect specimen, mostly a cast, but showing the disposition of the plaits on the inner lip; from *Kullygoody*; *Trichinopoly* group; 11-11a, front and back-views of a nearly complete specimen; *Pondicherry*; *Valudayur* group.

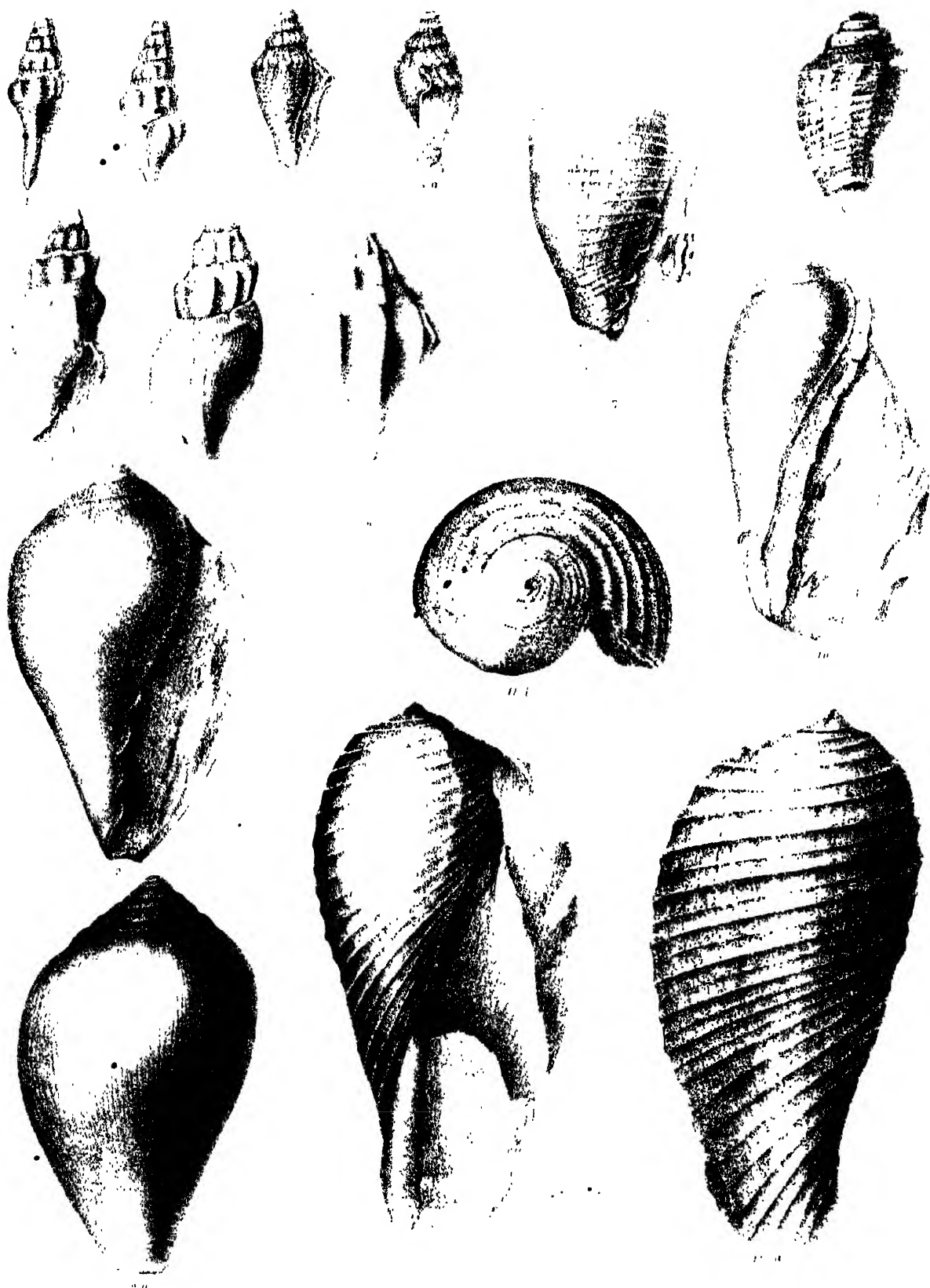


PLATE VII.

Figs. 1—9. *FULGURARIA ELONGATA*, *D'Orb.*, sp., p. 87, specimens of different shape, in some of which the wanting portions of the shell have been restored in outline; see p. 88 for explanation of the different varieties; all the specimens are from the blueish or whitish sandstones stretching from *S. of Serdamungalum* towards *E. of Anapady*; *Trichinopoly group*.

RELAC

POTASS. INDIA

Gastropoda Pl. 1

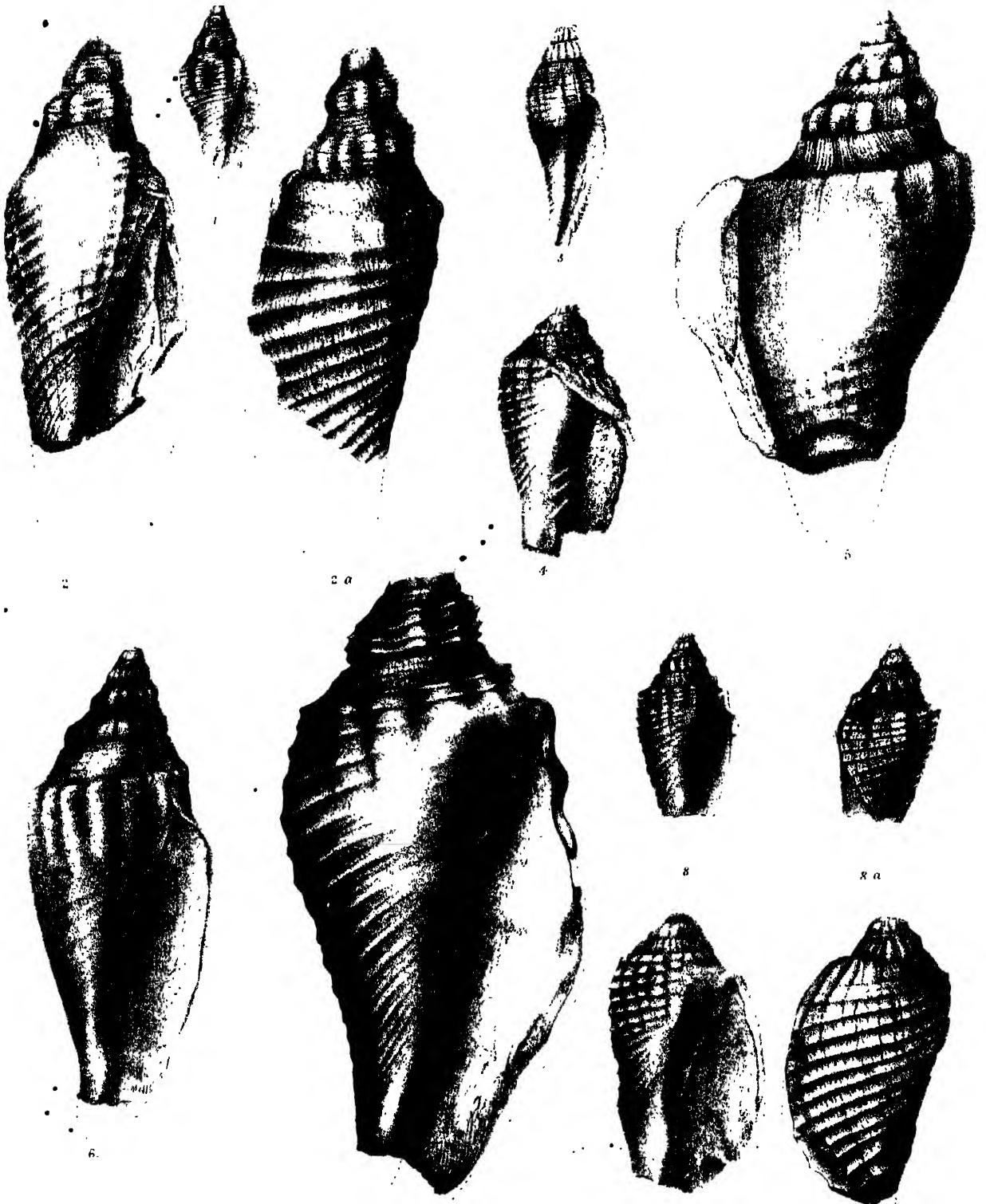


PLATE VIII.

Figs. 1—3. *FULGURARIA MULTISTRIATA*, *Stol.*; p. 89; 1, front-view of an imperfect specimen with the four columellar plaits exposed; 2, another front-view of a small, and 3, back-view of a large specimen; the probable shape of the shell restored in outline; *E. of Anapandy*; *Trichinopoly group*.

Figs. 4—7. *ATHLETA PURPURIFORMIS*, *Forbes*, sp.; p. 91; 4, front-view of the last whorl of an imperfect specimen, exhibiting the columellar plaits; 5, front-view of a nearly complete specimen, the posterior thickening on the margin of the aperture is specially marked; 6, back-view of an unusually inflated specimen, showing spiral striation only posteriorly, and the surface of the shell is all over perforated with some kind of shell-boring AMORPHOZOA; 7-7a, back-and side-views of a small specimen, showing spiral sulcation in the total height of the last whorl; the last figure exhibits the posterior direction of the striae of growth towards the groove; 4 is from the blueish sandstones near *Pondicherry*; *Valudayur group*; the other specimens are from the neighbourhood of *Kullygoody*; *Trichinopoly group*.

Fig. ... 8. *ATHLETA SCROBICULATA*, *Stol.*; p. 92; front-, side-, and back-views of a specimen from *W. of Kullygoody*; *Trichinopoly group*.



6

8

8 a

8 b

PLATE IX.

- Figs. 1—2. *VOLUTILITHES LATISEPTA*, *Stol.*; p. 93; 1—1*a*, front-and back-views of a specimen with smooth embryonal whorls and a fine spiral striation on the last; 2, back-view of a remarkably large specimen with few distant ribs; both specimens from near *Cumalypoorum*; *Arrialore group*.
- Figs. 3—4. *VOLUTILITHES ACCUMULATA*, *Stol.*; p. 94; 3—3*a*, front-and back-views, and 4, front-view; both specimens from the neighbourhood of *Olapandy*; the anterior portions of the shell have been restored in outline; *Trichinopoly group*.
- Fig. ... 5. *VOLUTILITHES MURICATA*, *Forbes*, sp.; p. 94; front-view of an imperfect specimen from the west of *Kullygoody*; ? *Trichinopoly group*.
- Fig. ... 6. *VOLUTILITHES RADULA*, *Sow.*, sp.; p. 95; front-and back-views of a very nearly complete specimen from the whitish sandstones near *Kullygoody*; ? *Trichinopoly group*.
- Figs. 7—8. *LYRIA FORMOSA*, *Stol.*; p. 97; 7—7*a*, front-and back-views of a specimen of usual size, the anterior portion restored in outline from another specimen; 8 showing the disposition of the columellar plaits; *Ninnyoor*; *Arrialore group*.
- Fig. ... 9. *LYRIA CRASSICOSTATA*, *Stol.*; p. 98; front-and back-views; the shell surface is only partially preserved on the upper whorls; *Comarapolliam*; *Arrialore group*.
- Figs. 10—11. *LYRIA GRANULOSA*, *Stol.*; p. 99; 10—10*a*, front-and back-views of a large specimen, and 11, a fragment exhibiting the disposition of the plaits on the inner lip; both from the whitish sandstones between *Andoor* and *Veraghoor*? *Trichinopoly group*.
- Figs. 12—13. *VOLUTOMITRA CANALICULATA*, *Stol.*; p. 100; 12—12*a*, front-and back-views of a nearly complete specimen, but the aperture is too much obliterated by the adhering rock; 13, front-view of another specimen, showing two of the three columellar plaits present; near *Serdamungalum*; *Trichinopoly group*.
- Fig. ... 14. *MITREOLA CITHARINA*, *Forbes*, sp.; p. 103; front-and back-views of an imperfect specimen, the figure having been completed according to that of Prof. Forbes in *Geol. Trans.*; *Pondicherry*; *Valudayur*-or *Arrialore group*.
- Figs. 15—16. *TURRICULA ARRIALORENSIS*, *Stol.*; p. 104; 15—15*a*, front-and back-views of a nearly complete specimen; in 16 the outer lip has been partly removed so as to show the plaits on the inner lip; *Comarapolliam*; *Arrialore group*.

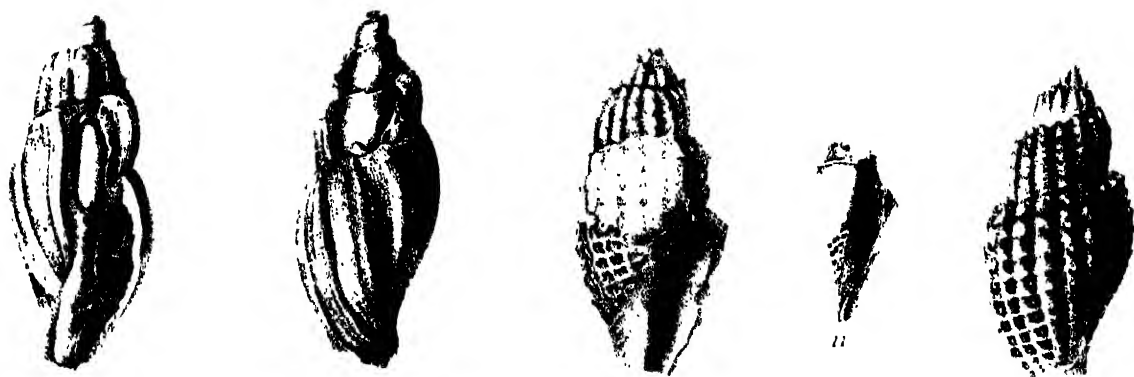
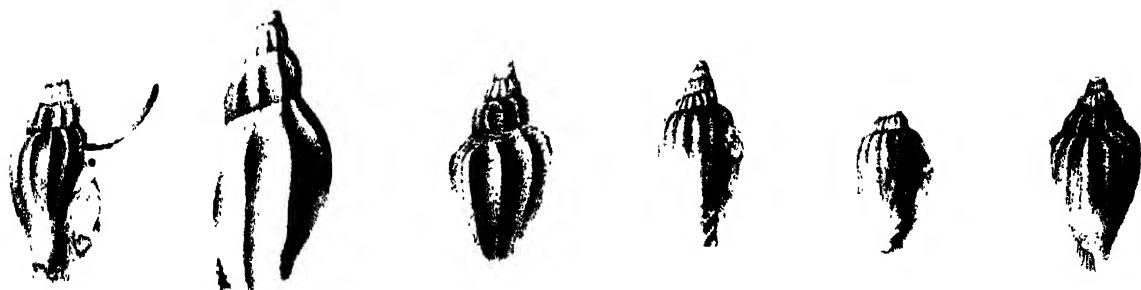
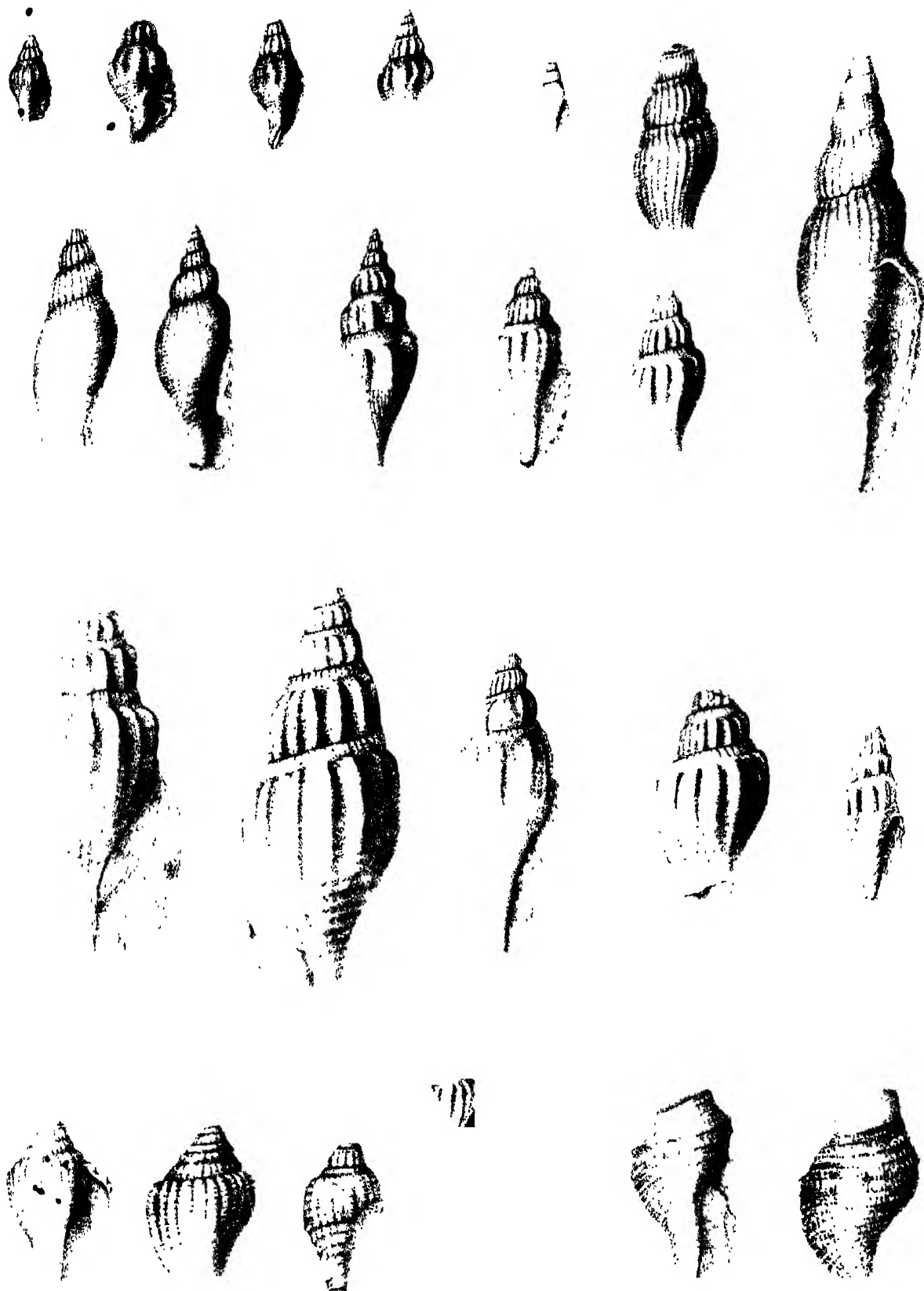


PLATE X.

- Figs. 1—4. *LATIRUS REUSSIANUS*, *Stol.* ; p. 107 ; 1, front-view of an incomplete specimen showing the columellar plaits ; 2, a specimen with much inflated last volution and shorter anterior canal ; 3, complete specimen of usual form ; 4, elongated specimen with the anterior canal complete ; all from the neighbourhood of *Alundana-pooram* ; *Trichinopoly* group.
- Figs. 5—7. *FASCIOLARIA ASSIMILIS*, *Stol.* ; p. 110 ; 5, front-view of a small specimen, the transverse ribs being on it only little developed ; 6, back-view, spiral striation and transverse ribs are very prominent ; 7, front-view of a nearly complete specimen, the extreme margin of the outer lip being broken off, and the anterior termination restored in outline ; 5 and 7 are from near *Olapaudy*, and 6 from the neighbourhood of *Mulloor* ; *Trichinopoly* group.
- Figs. 8—9. *FASCIOLARIA CARNATICA*, *Stol.* ; p. 108 ; 8, back-view of a specimen from *Karapaudy* ; 9, front-view of another from *Olapaudy* ; *Arrialoor* group.
- Figs. 10—16. *FASCIOLARIA RIGIDA*, *Baily*, sp. ; p. 109 ; 10, back-view of a nearly complete specimen, only the extreme termination of the canal being broken away ; 11—15, front- and back-views of different specimens of various sizes with more or less numerous transverse ribs and spiral striæ ; 16 exposes the three plaits on the inner lip ; all specimens are from the same beds between *Serdamungalum* and *E.* of *Anapaudy*, as the *FULGURARIA ELONGATA* ; *Trichinopoly* group.
- Figs. 17—18. *HEMIFUSUS CINCTUS*, *Stol.* ; p. 114 ; 17-17a, front- and back-views ; the anterior portion of the canal has been restored from another specimen, and can be considered as perfect ; from between *Andoor* and *Veraghoor* ; 18, front-view of an imperfect specimen with the spiral ribbings somewhat granulated ; *Alundana-pooram* ; *Trichinopoly* group.
- Fig. ... 19. *HEMIFUSUS ACUTICOSTATUS*, *Stol.* ; p. 115 ; front- and back-views ; the anterior canal restored according to its probable shape ; *Comarapolliam* ; *Arrialoor* group.
- Fig. ... 20. *FUSUS VERTICILLATUS*, *Stol.* ; p. 122 ; front- and back-views ; the outlines indicate the probable shape of the shell ; *Odium* ; *Oolatoor* group.
- Fig. ... 21. *NEPTUNEA RHOMBOIDALIS*, *Zekeli*, sp. ; p. 120 ; front- and back-views of a nearly complete specimen ; *Karapaudy* ; *Arrialoor* group.



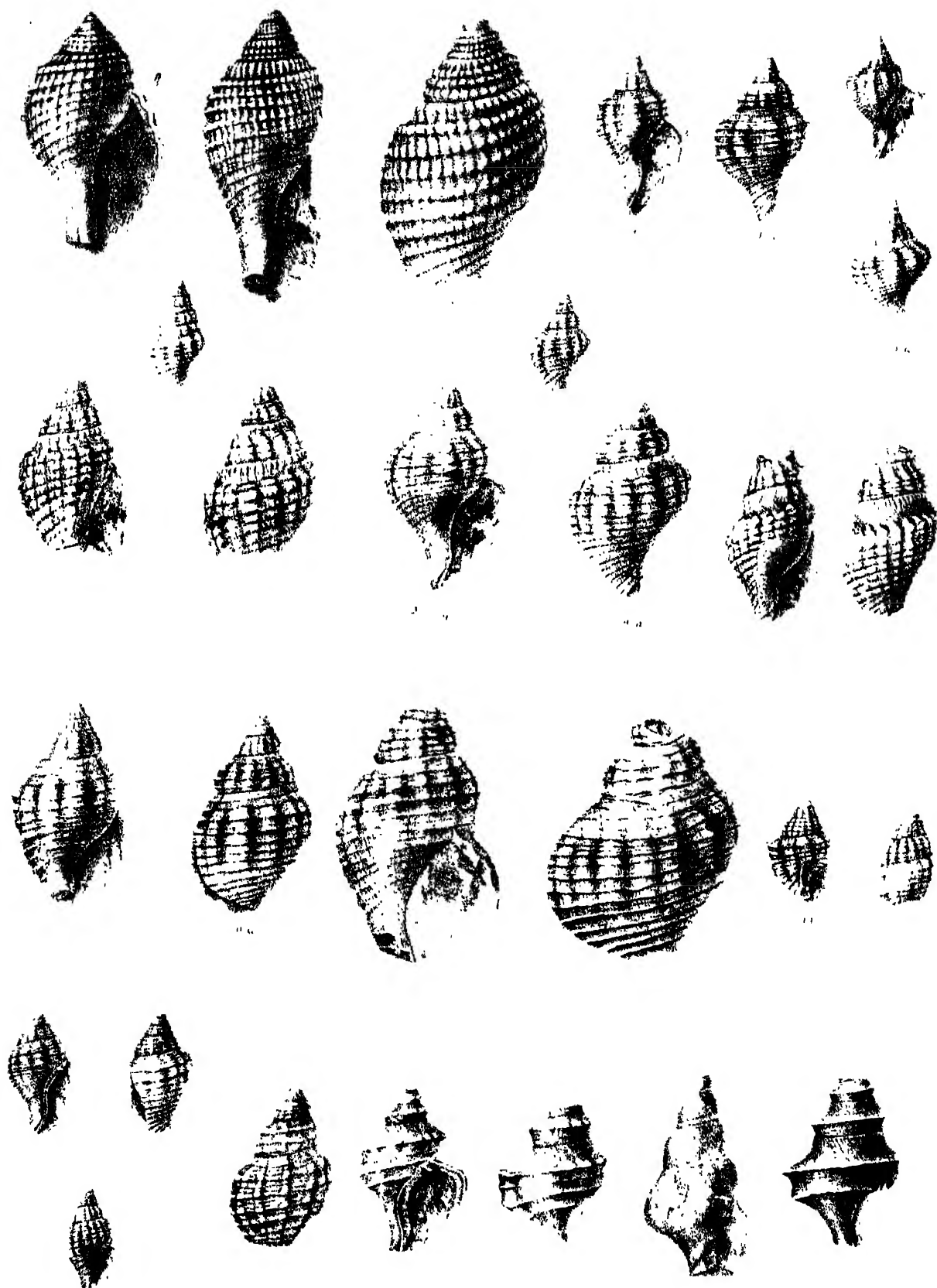
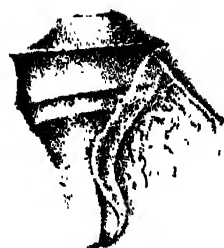
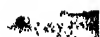


PLATE XII.

- Fig. ... 1. *COLUMBELLINA*, sp.; p. 139; front-and side-views of a cast specimen from near *Odium*; *Ootatoor group*.
- Fig. ... 2. *PSEUDOLIVA SUBCOSTATA*, *Stol.*; p. 145; front- and back-views; the anterior termination has been restored to its probable shape; *Ninnyoor*; *Arrialoor group*.
- Fig. ... 3. *NASSA ARRIALOORENSIS*, *Stol.*; p. 144; front- and back-views; the aperture partially restored; *Vaitagoody*; *Arrialoor group*.
- Fig. ... 4. *NASSA VYLAPAUDENSIS*, *Stol.*; p. 144; 4, front-view; the aperture partially restored from another specimen; 4*a*, one whorl increased, showing the disposition of the transverse ribs and spiral striæ; *Vylapaudy*; *Arrialoor group*.
- Figs. 5—8. *TUDICLA EXIMIA*, *Stol.*; p. 151; 5, front-view of a well preserved specimen with the aperture, the canal has been indicated in outline; 6, back-view, a small specimen with two anterior, thinner keels; 6*a*, top-view of the same; 7, back-view of a large specimen with only two keels, which become obsolete near the aperture; 8, back-view of a cast; and 8*a*, top-view of the same; all specimens are from the neighbourhood of *Karapaudy*; *Arrialoor group*.
- Fig. ... 9. *RAPA ANDOORENSIS*, *Stol.*; p. 153; front-and back-views of a well preserved large specimen; the anterior termination of the canal is only indicated in outline. *Andoor*; *Trichinopoly group*.
- Figs. 10—11. *RAPA NODIFERA*, *Stol.*; p. 153; 10, front-, 10*a*, back-views of a large specimen, the canal being only indicated; 11, a small specimen; both from near *Coonum*; *Trichinopoly group*.
- Figs. 12—16. *RAPA CANCELLATA*, *Sow.*, sp.; p. 154; 12 a small specimen with the extreme margin of the outer lip broken off; but with the anterior canal almost perfect; from near *Serdamungalum*; 13-16, specimens of different sizes with the outer and inner lips mostly well preserved, the columella becoming gradually more excavated, as the size of the shell increases, while the anterior canal appears to become shorter in proportion; all specimens from *W. of Kullygoody*; *Trichinopoly group*.



12 b



PLATE XIII.

- 1—4. *RAPA CANCELLATA*, *Sow.*, sp.; p. 154; 1, front-view of a large specimen with perfect margin of the outer lip; from *E. of Anapandy*; 2, back-view of a specimen with two stronger peripheral keels; 3-3a, front-and back-views of specimen with more evenly convex last whorl; both are from near *Kolakonuttom*; 7, back-view of a specimen with the transverse ribs somewhat stronger, than is usually the case; from *E. of Anapandy*; *Trichinopoly group*.
- ... 5. *RAPA CORALLINA*, *Stol.*; p. 155; front-and back-views of a small specimen; the outer lip is partially perfect, but the anterior canal is only indicated by an outline; *Nannoor*; *Arrialore group*.
- ... 6. *RAPANA TUBERCULOSA*, *Stol.*; p. 156; front-and back-views of a small specimen; *Serdanungalum*; *Trichinopoly group*.
- 7—9. *TRICHOTROPIS KONINKI*, *Müller*, sp.; p. 158; 7, back-view of a large specimen, with much elevated spire; 8, front-view of a smaller specimen with shorter spire; the inner lip is perfect, and the margin of the outer lip nearly so; 9, back-view of a portion of the spire; all specimens from *E. of Anapandy*; *Trichinopoly group*.
- ... 10. *TRICHOTROPIS NODULOSA*, *Stol.*; p. 159; front-and back-views of a somewhat incomplete specimen; *S. W. of Alundanapooram*; *Trichinopoly group*.
- ... 11. *CANCELLARIA ANNULATA*, *Stol.*; p. 162; front-and back-views; the anterior termination of the shell is only indicated in outline; *Olapandy*; *Arrialore group*.
- ... 12. *CANCELLARIA (EUCLIA) BREVIPLICATA*, *Forbes*, sp.; p. 163; front-and back-views; the anterior termination is restored in outline; *Comarapolliam*; *Arrialore group*.
- ... 13. *CANCELLARIA (EUCLIA) INTERCEDENS*, *Stol.*; p. 164; front-and back-views; only the apex and the extreme margin of the outer lip are not perfect in the specimen; *Comarapolliam*; *Arrialore group*.
- ... 14. *CANCELLARIA (EUCLIA) CAMDEO*, *Forbes*, sp.; p. 165; front-and back-views; only the posterior portion of the outer lip is imperfect; near *Comarapolliam*; *Arrialore group*.
- 15—16. *NARONA EXIMIA*, *Stol.*; p. 166; 15-15 a, front-and back-views of a complete specimen; 16, front-view of another with more inflated last volution and a shorter spire; from near *Alundanapooram*; *Trichinopoly group*.



